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SPORTING RIFLES AND RIFLE SHOOTING

THEODORE ROOSEVELT
From an unpublished photograph taken at Jinja, Uganda, in 1910

SPORTING RIFLES AND RIFLE SHOOTING

BY

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TO THOSE SPORTSMEN AND EXPLORERS WHO HAVE PASSED OVER THE FAR RANGE AND HAVE FOUND THEIR GREAT DESIRE IN THE HAPPY HUNTING GROUNDS; AND IN PARTICULAR TO THE MEMORY OF THE ONE WHO STANDS PREËMINENT AMONG THEM AS THE PERSONIFICATION OF AMERICAN PATRIOTISM AND CLEAN SPORT

THEODORE ROOSEVELT

PREFACE

What visions the rifle conjures to memory! It is the very embodiment of the American spirit, a magic carpet which takes us to many lands and always to deeds of daring or of fame. There is nothing mean or petty in these visions. They are all of the great outdoors, of nature, of God's footstool, of the distant portions of the world, of the back blocks of civilization.

And what names and events we remember in connection with the rifle and its use! Does not the flintlock bring memories of the *voyageur* or the *coureur du bois* of the French and Indian Wars, with his buckskin-fringed leggins, coonskin cap, powder horn and bullet pouch; of the New England farmer causing the rout and retreat of the British at Lexington and Concord? Does not Sharp's "Old Reliable" buffalo gun conjure up the long lines of prairie schooners and the rush to the Great West, the slowly advancing civilization, the pushing forward of the great railroads which unified this country? Can we not see the "thin red line" of British riflemen in the

Crimean War, stopping and shattering the onrush of Russian cavalry? Does not the Winchester 44, our famous gun of the early seventies, recall the wonderful stories of grizzly, of elk, buffalo, and deer, the arrival of our Industrial life at the last frontier of nature?

Then the heavy double elephant and big-game rifles! What tales they tell of stirring encounters in forest or jungle; what hairbreadth escapes, what memories of mighty hunters, what names, famous for all time, as men of the great outdoors, as brethren of the community called the world! They conjure long vistas of scenes in the far corners of the earth, of camp with the porters at evening meal around their little fires, of the Somali at sunset telling his beads to Allah, of the bamboos with their feathery tops, of the clear, wonderful atmosphere of the Highlands of Africa.

In our own land, with the smaller-bore high-power rifles we may see in the firelight visions of the clear evening light across the calm lake, the moon just rising, the violet light descending on the autumn tints of foliage on the hills, and hear once more the answer of the great bull moose as he comes to his lovemaking. Or, perhaps, it is

among the rocky peaks above timber-line, every feature clear and distinct at the great altitude, that our hunt has taken us for sheep or goat. We can recall the first flush of morning across the snow-capped mountains in the distance, with its faint tints of rose and saffron, the forerunner of a perfect day, our camp below in the little gulch with the noisy stream and the sweet scent of pine and balsam, the pungent smoke of the campfire, and the faint tinkle of the bell-mare with our pack ponies.

And to come to the nearer present, who can forget the wonderful rear-guard action of the British from Mons, when the shooting of the "Old Contemptibles," nucleus of that great fighting machine, the British Army, saved the day for the world; enabling the French to collect their forces for the combined effort at Meaux which resulted in the repulse of the Germans at the first Battle of the Marne; or the action of our own Marines at Château-Thierry, deliberately changing their sights, as a French officer of the General Staff told me, in the face of the enemy advancing across the wheat field, where once again riflemen in open formation checked the advance of German infantry which greatly outnumbered them.

The rifle is the one weapon justified by civilization, for it is an instrument through which man may assert the supremacy of mind over matter. It is the mechanical medium through which we are enabled to overcome the problems presented by Nature, be they those of the elements or of the habits of game. To use it recalls no memory mean or small. All the greatest achievements in sport or in war have been connected with its use.

The rifle stands for law and order in times of peace, and skill in its use is of inestimable value in times of war, upholding those ideals which are next to man's very soul, the preservation of hearth, home, and country. It takes a man from the sordid cares of life to the great wilderness, where he can get a breath of God's pure air, to the solitude of the Northland or the misty, steamy jungle of the Equator. It gives the human soul a chance for introspection untrammeled by civilization, brings him nearer to Nature and to realization of the Great Beyond.

It has been my good fortune to have been for a good many years in a position to see not only the theoretical and scientific, but also the practical side of rifle shooting. The notes and suggestions contained in this book are the result of experience

in many lands and against practically all kinds of game, as well as on the target range and in actual military service.

Its purpose is to supply data for the hunter against game and to give both hunter and target shooter more simple solutions of the rather intricate methods in use for the calculation of elevation, windage, and atmospheric conditions. For the benefit of those not conversant with the rifle, I have added a glossary of technical terms in use among riflemen and a simple explanation of the fundamental principles involved in rifle shooting.

J. C.

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CHAPTER I

RIFLE TYPES

Few men who use the rifle to hunt with are thoroughly conversant with the scientific side of rifle shooting; those who are cognizant only of its range use are unaware of the rough side, devoid of all refinement of sights, ammunition, cleaning, etc. Yet theoretically both target work and the use of the weapon in the field are intimately related; in fact, they cannot be separated.

Here in America we are inclined to trust too much to the claims made by their makers for new types of weapons. It is a long way from the elaborate sporting-goods store with its attractive display of rifles to the thickets of Kadiak Island or the thorn scrub of Africa; and the hunter generally learns to his cost that the salesman was unacquainted with the actual use of his

rifle against heavy game. So, too, with many of our writers in the sporting magazines; they write of the effect of bullets on game which they have never seen except in a menagerie.

For many years we have heard of the all-around rifle. There is no such thing. True, there are rifles that may be used for both target and sporting purposes, but with the exception of the U. S. Springfield '03 and rifles of that type which have been introduced in recent years, few, if any, fulfill adequately both requirements, and these are mainly for long-range target work. Many times one is asked which is the best rifle, and the questioner seems rather put out at the answer: "What for?" Now each rifle is made for some specific purpose and then adapted to others.

The main requirements of a sporting rifle are accuracy and sufficient power to deliver a killing blow to the game shot at.

All game animals may be divided into two classes—dangerous and non-dangerous. In the United States we have practically no really dangerous game with the exception of the larger bears and possibly the moose. Then, too, game is not dangerous unless charging or seeking life,

and so we may cut down the chances of danger to about three per cent. in the case of moose and not more than ten per cent. with bear. My personal experience with moose extends over some sixteen years of shooting, and during that time I have seen over three hundred, but in no case did any moose attempt to attack uninjured. In 1902, at Amqui, Quebec, I made an offer to pay fifty dollars to any one who would go before a notary or *curé* and make a statement under oath that he had been attacked by a moose unprovoked. So far no one has claimed the fifty dollars. Many *habitants* have assured me that a wife's cousin or other relative or acquaintance had been treed from two hours to two days by a moose, but the actual subject of attack has not appeared.

So, too, in Africa. The unprovoked charge of animals is almost unknown, although a rhino or a lone bull buffalo will sometimes, and an elephant will generally, charge the scent up wind, and an old rogue elephant is an ugly customer.

For all types of game shooting only three rifles are necessary: (1) A small, light weapon without recoil and with inexpensive ammunition for grouse, rabbits, birds, and small animals;

(2) a powerful small-bore, high-velocity weapon with good shocking power for all non-dangerous game; and (3) a heavy weapon of great power for the larger pachyderms. These requirements are fulfilled by the 22-caliber repeater handling the long-rifle cartridge for rifle 1; by the U. S. Springfield '03 chambered for the '06 cartridge, carrying the 180-grain bullet with 2,700 foot-seconds velocity for rifle 2; and by a double cordite rifle of 450-bore or greater with a bullet of 480 grains weight and a velocity of 2,150 foot-seconds for rifle 3.

These are the minimum requirements. Now let us see what energy the various weapons develop, not at the muzzle, but at the average range at which the game is hit.

The 22-long rifle with a 40-grain bullet and a charge of 3.4 grains of Lesmok powder develops a muzzle velocity of 1,035 foot-seconds and an energy of 82 foot-pounds at 50 yards. This is the actual limit of range for this little gun to do effective work and *kill,* so we may call the necessary energy at usual ranges for this rifle 75 foot-pounds. A 30-caliber rifle with 180-grain bullet developing a muzzle velocity of 2,720 foot-seconds gives a striking energy of 2,560 foot-

pounds at 100 yards; and the 450-bore, 480-grain, 2,150 foot-seconds rifle gives us 4,180 foot-pounds at 100 yards. We may, therefore, take the blow needed to kill game cleanly and neatly as follows:

Small game . . .	75 foot-pounds	at 50 yards
Non-dangerous game	2,500 foot-pounds	at 100 yards
Heavy game .	4,000 foot-pounds or more	at 100 yards

The Springfield may be loaded with the regulation service charge, with the 150-grain bullet of 2,700 feet per second velocity, and still be strong enough for all eastern game; if for use in Maine and the eastern states, a still further reduction of the power of the cartridge to give about 2,000 feet velocity and 1,700 foot-pounds of energy will make a good deer gun. It must be remembered, however, that although reduced velocity and reduced energy give accurate shooting and lighter recoil, one is not utilizing the full capacities of his weapon either as to range or killing power; and also that when a low-power load is used with a lead bullet, the fouling remaining in the barrel will render the service cartridge with its metal-patched bullet inaccurate.

Now as to the individual merits of different

types of rifle 1. Nearly all commercial 22-caliber repeaters are made ridiculously small and light; in fact, the stocks would hardly fit a boy ten years of age. In former years one could obtain a rationally shaped rifle of decent weight only by using a 22-caliber barrel on a single-shot action. Then, too, the repeaters were nearly always faulty in functioning the 22-long rifle cartridge. From the appearance and balance of recent military arms, however, it would seem that the manufacturers have at last realized that the demand is for a 22-caliber rifle of proper size for the average man.

The best rifles for military target use and for small game handle a 22 long-rifle cartridge, and lately a type of gun has been placed on the market conforming very generally with the regulation Springfield rifle in weight, size, and action. Both the Winchester and the Savage Arms Company make weapons of this type. I think the Winchester with its six grooves will handle the small bullet better than the Savage with four. One fault of both of these rifles is that they are bored a little too small for the diameter of the bullet employed. These guns make most excellent sporting weapons when restocked or with

FIGURE 1. 22-CALIBER WINCHESTER BOLT-ACTION RIFLE, 1920, FITTED WITH SPORTING STOCK
FIGURE 2. ACTION OF 1920 22-CALIBER WINCHESTER

the original stock altered to suit the shooter. I find the stock as turned out by the factory too short, and it is best to lengthen it by a thicker vulcanite butt plate. The forehand may be cut down and an additional cap of vulcanite put on the end of the pistol grip, which will make it conform better to the average man's hand.

The sight also should be changed, and I think for game shooting that a Sheard gold bead front sight one-sixteenth of an inch in diameter or

FIGURE 3. SHEARD GOLD BEAD FRONT SIGHT

one of King's sights of similar pattern is best seen. The rear sight as supplied with the rifle cuts off entirely too much of the surrounding landscape, and a Lyman 103 tang sight or a Lyman 48 adapted to the original sight block is the best. One must bear in mind that for all practical purposes a 22 is only an understudy to the more powerful weapon, a preparation and training, so to say, for the Springfield, with the advantages of cheap ammunition and limited range and danger zone. The nearer we conform either to the military or sporting type of the larger gun in

every detail, the better preparation for its use at longer ranges or in the field.

Now let us take up the gun that will be the most used in hunting game of any size, non-dangerous. Here we are limited in diameter of bore from 256 to 300 thousands of an inch and have open to our choice the Manlicher, Mauser, Ross, and Springfield. First let me say that the seven-millimeter or 275-bore is the nearest approach to the ballistic ideal, both as to wind cutting and range. We have the seven-millimeter Mauser with a charge of 42½ grains and bullet of 139 grains, velocity at the muzzle, 2,784 foot-seconds, energy at 100 yards, 2,057 foot-pounds. The weak point is our energy, which falls nearly 500 foot-pounds below the required standard and puts this rifle out of consideration for all but deer and lighter game. With the 280 Ross we have a bullet of 145 grains, muzzle velocity, 3,050 foot-seconds, and energy at 100 yards, 2,595 foot-pounds, but we encounter another problem in this gun. The bullet is too light to sustain the velocity and therefore breaks up badly before it can penetrate far enough into the body of game for its energy to be effective on the vital organs. The 280 with the 180-grain bullet and 2,700 foot-

second velocity is beside the question, as I know of no action that will feed it through the magazine and function. Then, too, its energy is not as great as the 145-grain bullet, being only 2,584 foot-pounds, although it is very much more effective on account of the heavier bullet.

The unreliability of the 145-grain bullet, 280-bore Ross was clearly demonstrated on Kapiti Plains, British East Africa, in January, 1911, when Mr. George Grey, a brother of Viscount Grey, met his death when using this weapon by being mauled by a lion. Sir Alfred Pease, Captain Slatter, young Pease, one of the Hills, and George Grey were riding lion. Mr. Grey had followed up a lion which finally stood at bay at about 100 yards distant. Grey dismounted, whereupon the lion charged and he fired three shots at the lion as he was coming head on (his pony having bolted); two hit the lion in the face and mouth, but, owing to the angle of the skull, merely cut a gutter in his muscles and did not penetrate; the bullets evidently expended their efforts superficially on the bone. The lion downed Mr. Grey and proceeded to chew his left arm. Sir Alfred Pease rode up with the others and fired a shot from a .256 Manlicher

which hit the lion a little too far back. As the lion turned he again shot at him, whereupon the animal returned to maul Mr. Grey again who was still upon the ground. Then Slatter, who by the way has only one hand, having lost the other in the Boer War, went in close and finished the beast with a shot from a 450 No. 2 Cordite rifle. There seems to have been a general mix-up, as every one was afraid to shoot while Grey was on the ground under the lion. He was horribly mauled on the arm and shoulder and was rushed to the Nairobi Hospital, where he died four days later from his wounds.

There is a row of little white crosses in the Nairobi graveyard, where lie the victims of a misplaced confidence in the gun-maker's assertion that a small bore with sufficient velocity will stop anything.

One more instance of the Pukka Shikarri's opinion of the very small bore, high-velocity rifle. Some years ago when the 22 high-power Savage was first put on the market, it was exploited in many of our magazines by a picture of a tiger killed with one shot in Upper Assam, India. One was given to understand that it was done by a man who heard a noise during the

night in the tea-patch near his house. He opened the window and fired at the intruder, and found out in the morning that he had killed a tiger. Shortly after this a Mr. X from somewhere in the West wrote to *Forest and Stream* advocating and strongly recommending the use of the 22-caliber high-velocity Savage rifle on all except the very largest pachyderms. He said incidentally that any man who used heavy ordnance was a coward. To this I replied in the same paper that no man in his senses would employ any but the weapon recommended by men of experience, a 450-bore No. 2 Cordite or better, against the larger Felidae in heavy jungle. Mr. X did not reply. But as I wished to have an opinion on the subject, I sent two copies of the paper to Major R. J. Cunninghame in Nairobi. In due course I received a reply in which he said:

If Mr. X and his friends of 22 high-velocity persuasion will buy a *one way* ticket to Mombasa and will come here with their 22 Savage rifles in one hand and their last will and testament in the other, I will put them up against lion, and will wager what you like that they will quickly have use for the latter instrument if they employ the former.

Now, the two instances are merely given to show that it was generally conceded that something more than energy, however great it may be, is necessary, if the said energy be expended superficially.

We require energy, but we must also have the vehicle to convey it to that portion of the body of the animal where it will reach and expend its force on the vital organs. In order to accomplish this, we must have a bullet of sufficient weight and stability to carry deep enough to do its work efficiently.

CHAPTER II

GAME RIFLES

For use against non-dangerous game, I most strongly recommend a 30-caliber with a bullet of sufficient weight to carry the energy of the cartridge deep enough to reach the vital organs of the game. Much has been written about the medium-bore high-velocity weapon. It is my experience that the 35-caliber, the nine-millimeter, the 375-bore and the 405-bore are purely superfluous weapons in a battery, for if we want a gun to give a smashing blow, enough to stop or turn a charging animal, we want one that will deliver a shock absolutely certain to kill or turn it. The medium-bore high-velocity rifles cannot be relied upon to do this. Their heavier bullets and higher trajectory place them in the inaccurate class; thus, they are not dependable when used against the largest game. On looking through my game book, I find that it contains a fair comparison of various rifles and details of shots at almost all kinds of game.

In 1897, I used a 30/30 Winchester which was not powerful enough even for moose. I shortly changed to a Winchester 1895 model, taking a 303 Lee-Metford cartridge. For in those days one could obtain expanding bullets of more variety and type for this cartridge than for our own 30/40 Krag, while the ballistic value of the two weapons is almost identical. I found, however, that for woods shooting, the 303 was not sufficiently powerful for the quick shot or two usually obtained at moose, and therefore changed to a 375-bore Holland and Holland Manlicher, shooting a charge of 40 grains of Cordite and a soft pointed bullet of 270 grains weight. I found that for shots at short range under 150 yards it almost ideally fulfilled the requirements of a moose gun, invariably killing with one or two shots when well placed. This rifle was superseded by a 375 double by Holland, shooting 42 grains of Cordite and a 300-grain bullet. The ballistic value of this cartridge is almost identical with the 405 Winchester, with this advantage, however, that the axis of the bullet of the 375 is longer than that of the 405 and the vehicle, therefore, is more dependable in carrying the shot through the shoulders of a moose, since more of

the base remains to drive in the expanded point of the bullet.

I used this gun for eight years, chiefly in Canadian shooting, and found it in all respects extremely satisfactory. Practically all of the expanded bullets remained in the body of either moose or caribou if hit anywhere about the chest or fore shoulders.

With the introduction of the United States Springfield model 1903, I tried the earlier pattern of cartridge with the 220-grain bullet on moose and found that its fault, as compared with the 375, lay in the lack of shocking force. When the cartridge was changed in 1906 to the sharp pointed 150-grain bullet of 2,700 foot-seconds velocity, I found that the velocity was too great for the soft point expanding bullet, especially on heavier game, and that they broke up superficially many times. With the 150-grain solid bullet, provided a heavy bone was hit, the bullet generally tumbled or keyholed, making a slashing wound.

In 1910 I found that the 375-bore was not powerful enough for the heavy African game. As notes in my game book, often repeated, show: "Used the 465 to finish with." This led me to

discard the 375-bore, for I found that the Springfield with the 180-grain solid bullet was fully as good a killer and infinitely more accurate at the longer ranges encountered on the veldt, while for the smaller antelope the 150-grain soft pointed bullet with 2,700 foot-seconds velocity was almost what was required. I say "almost" for I had some cartridges loaded with 165-grain 30/30 bullets, and found their killing qualities excellent, the only drawback being the changes in sight necessitated by the blunt-pointed bullet in place of the sharp Spitzer.

After all, the remaining energy of the Springfield 180-grain, 2,700 foot-second velocity cartridge at 100 yards is the factor that we can count on; for it is greater at that distance than that of the 375 Cordite or 405 Winchester, while infinitely superior in accuracy; this, together with its low trajectory, makes a hit in a vital part on game easier and the absolute judgment of distance not so important.

Now, finally, we come to the selection of the heavy rifle, the life-saver. In this choice we are governed primarily by the shocking force needed at the distance ordinarily used, which must be sufficient to stop the charge of heavy and dan-

FIGURE 6. PURDEY DOUBLE 465 CORDITE RIFLE; UNDER-LEVER SCREW-GRIP ACTION, OPEN SIGHTS, RUBBER RECOIL BUTT PLATE; WEIGHT, 11¾ POUNDS

FIGURE 7. HOLLAND & HOLLAND DOUBLE 375 CORDITE RIFLE; SNAP TOP-LEVER ACTION, LYMAN TANG REAR SIGHT, FITTED RUBBER RECOIL BUTT PLATE; WEIGHT, 9¾ POUNDS

gerous game or at least turn it aside. In the general conditions which prevail against such game, we may assume these premises:

(1) Game is not dangerous unless it charges.

(2) When charging, a head shot will be generally required.

(3) The distance is usually short, not over 50 yards.

(4) A reasonable amount of accuracy is needed in the weapon to place a shot under the strain of excitement in or near a vital point at that distance.

It is the general consensus of opinion among experienced hunters of heavy game that a rifle with 5,000 foot-pounds muzzle energy will kill at a distance from 50 to 100 yards, and that by using a larger weapon we handicap ourselves by the weight and time required to recover from the severe recoil for a second shot; therefore, a rifle of 450-bore, shooting a bullet of 480 grains weight with a muzzle velocity of 2,150 foot-seconds, has become the standard weapon for this work.

The 475- and 465-bore rifles are merely modifications of the above cartridge, as it is against the law in most British colonies for sportsmen to

employ guns of the same caliber as the Martini-Henry 450-bore or to import cartridges taking bullets of that size.

The accuracy of such a weapon, which is almost invariably a double rifle, is a four to five-inch group using both barrels at 50 yards, while its weight is between 11 and 13 pounds.

The 256 Manlicher has been rated favorably for many years as a reliable gun against non-dangerous game. Its reputation is, I think, due rather to accuracy than to its shocking power. The normal cartridge of 2,550 foot-seconds velocity, with a bluff soft-nosed bullet, has scarcely energy enough to kill cleanly game of any considerable size. It will be noted that it does not come up to the general requirement of 2,500 foot-pounds. With the solid bluff pointed bullet, extremely good penetration is obtained, as the following instance will show.

In Africa a very well known elephant shot and his wife came upon a herd of elephants. They both tried the head-shot on two of the beasts about 60 yards away, both animals standing close together and side on. Mr. X and his wife each aimed at exactly the same spot on each animal, halfway between the orifice of the eye and the ear

at the forward edge of the ear flap. Both animals went down stone dead from brain shots. Mrs. X was using a 256 Manlicher with solid bluff pointed bullets, while Mr. X had a 475 Cordite with solid metal jackets. The tiny bullet, so well placed, had equaled the big gun in this instance; but Mr. X still advocates and strongly advises the use of the 475, because at close quarters, should a charge occur, it will turn an elephant with a stunning shock, even if the brain is not reached, as more power is transmitted laterally by the larger bullet.

About ten years ago Gibbs of Bristol introduced a magnum Manlicher, 256-bore, with pointed bullet of 3,100 foot-seconds velocity. This weapon has been used extensively and tried out pretty thoroughly in Africa and against the heavy bear and walrus of the Arctic; the verdict has been that the bullet is too light for the velocity of the cartridge and breaks up before penetrating the vital organs of the animal. Both in Africa and in the Arctic with Steffanson, the breech pressure developed is greater than the primer pocket could stand, causing a blow, back past the edges of the firing pin, of small particles of copper and foil from the primer. All of

which goes to show that the velocity of the cartridge has been forced too far.

A rather general rule may be applied to the extreme velocity cartridge with the normal weight of bullet: 100 feet per second for each 1/100th of an inch diameter of the bullet will give us a rational cartridge without dangerous pressure or undue premature disintegration of the bullet on impact, provided that the longer type of bullet is used.

And now the question arises of the 30-caliber rifle. This cartridge has the advantage of being the standard adopted by the government of this country and we have at hand infinitely more data to base our opinion as to its utility and effectiveness than we have on any other. Then, too, not only from year to year but from week to week, one may compare the scores made with this cartridge in the various rifle competitions. It takes us from theorizing and experimental work to the actual effect and results obtained.

There are two types of 30-caliber United States Government cartridges, the Krag 1898 model and the Springfield 1906 model, the former with 2,000 foot-seconds velocity, the latter with 2,700. The 30-caliber Krag cartridge, while

FIGURE 8. KRAG, U. S. MODEL, 1898, FITTED WITH POPE EIGHT-GROOVE BARREL AND WITH POPE MICROMETER ON REAR SIGHT

FIGURE 9. 30/40 WINCHESTER SINGLE-SHOT RIFLE FITTED WITH ZEISS PRISMATIC TELESCOPE, WINCHESTER BARREL MOUNTS, AND LYMAN NO. 103 TANG REAR SIGHT

t quite heavy enough for the very largest game n this country, that is, moose and Alaskan bear, is nevertheless very useful and its case with a rim is more easily reloaded and is better adapted to single shot rifles than the 30 Springfield rimless. Then, too, the pressure is much less, being 39,000 pounds; but, even with all its usefulness and accuracy, the cartridge, compared with the more modern 2,700-foot type, is one of the past. If we care to reduce the velocity of a 30-caliber rifle it can be done as easily in the Springfield as in the Krag. If we look at the Springfield cartridge from a critical point of view it has many faults. Chiefly among these is the size of the powder chamber, which is too small, and therefore a more concentrated powder must be used to get the higher velocities now advocated with heavier bullets. Also, the neck taper is more abrupt than is necessary to hold the cartridge firmly against the blow of the firing pin, thus giving a greater initial chamber pressure than is necessary. The small diameter of the body of the cartridge case and head was adopted, I understand, because of the employment of the Mauser clips which were available after the Spanish War for experimental work in developing the rimless cartridge. A

comparison of the standard Government issue of the two cartridges is as follows:

	Springfield	Krag
Length of barrel, inches	22	30
Diameter of bore, inches	.30	.30
Weight of bullet, grains	150	220
Powder charge, grains	49.2	36.5
Primer	N.M.	N.M.
Muzzle velocity, foot-seconds	2,700	1,980
Breech pressure, pounds per square inch	49,000	39,000
Remaining energy at 100 yards, foot-pounds	2,034	1,553

Both cartridges lack the necessary energy to bring them up to our required standard of 2,500 foot-pounds at 100 yards. We can, however, do so by increasing the powder charge and using one of the more progressive types of powder.

If we increase the velocity of the 150-grain bullet to 3,000 feet per second, we will obtain the necessary energy and the not undue pressure of 56,000 pounds at the breech. But this method does not give us the sustained energy; besides, the bullet is too light to convey the increased power; it breaks up too quickly on impact and, with the increased velocity, is more erratic in its flight.

However, if we load the Springfield cartridge with the 180-grain bullet and raise the velocity to 2,700 feet per second, we obtain the muzzle en-

ergy of over 2,900 foot-pounds and the remaining energy, at 100 yards, of over 2,500 foot-pounds, with an average breech pressure of 44,000 pounds per square inch. This still retains for us our desired accuracy, with enough weight in the bullet to convey this energy through the muscles and bones of the animal and deliver the shock to the vital parts.

Theoretically, with an increase of weight and length in the bullet, we should employ a quicker twist to prevent stripping or cross-riding the lands; with the very imperfectly made bullets which were first issued with the Krag an extremely quick twist was found to give more accuracy. Some of the Palma Match rifles were made one turn in 8¼ inches, but it was found that with a more perfect jacket and a harder core of lead or alloy to the bullet, a slower twist was fully as accurate.

One of even one turn in 14 inches is amply sufficient to spin the 180-grain Springfield bullet true on its longer axis up to 1,200 yards. In this country we have followed this theory in special long range barrels for years, merely increasing the number of lands and decreasing their width to give more holding surface to the bore of

the rifle. An instance occurred some years ago at one of our arsenals which demonstrated the above. A rifling machine had by accident been boring an $11\frac{1}{2}$-inch twist and in the renovating of the machine-shop the set of the cutter on that particular machine was painted over and the error remained unnoticed, but the men who were testing the rifles on the range noticed that the barrels from this certain machine made better groups than those from the others. On investigation, the cause was found as above and the machine again set for the regulation twist, one turn in ten inches. A fine example of progressiveness.

Only recently in the development of a new 303 cartridge by the British Government, it has been found that with a bullet of 175 grains in weight and a muzzle velocity of some 2,800 foot-seconds, a twist of one turn in fourteen inches shows decided superiority over the quicker one.

With a 14-inch twist, we find that the drift is less than with a quicker ten-inch one, and therefore requires less allowance than the regulation barrel. This difference in drift, however, is practically negligible at all sporting ranges of under 500 yards.

Another fact that came to light in regard to the

drift of the Krag rifle was this: in one of the arsenals, while the rifles were being assembled, the action was clamped in a vise and the screw of the upper band was set home with the muzzle of the barrel unsupported. This evidently gave a set to the barrel, for when the proper support for the muzzle was used, much of the mysterious drift disappeared.

FIGURE 10. POPE'S LATEST FORM OF 30-CALIBER LONG-RANGE RIFLING

The very best form of rifling is that employed by Pope; a modified ratchet multi-groove with relief on the back or non-driving side of the land, the edges of the lands and the corners of the grooves slightly rounded to relieve the strain on the metal jacket of the bullet. This also facilitates cleaning. Then, too, the number of lands should be increased practically in direct ratio to the decrease in width, so that with a six-groove

barrel the width of the land should be one-sixth of the width of the groove.

Another point to be considered is the diameter of the bullet. The late F. W. Mann clearly demonstrated the superior qualities of a bullet of bore diameter for accuracy. This was, however, more marked with lead bullets, which upset readily and more quickly formed a gas check, than bullets with the metal jacket. The theory has been carried out in the bullet used for Schuetzen rifles 32/40 and 38/55 caliber with the base band, the diameter of the grooves and the forward bands of land diameter, known as the two-cylinder bullet.

There has recently been designed a metal-jacketed bullet which fulfills these requirements and merely utilizes the lesson learned many years ago as to the composition of the filling or core of the bullet. Two different alloys of lead are used, the one at the base pure lead or very soft alloy; with this core we automatically get base expansion by the pressure of the discharge, which in turn is transmitted to the metal jacket. Thus we have a metal-jacketed bullet of the two-cylinder type made automatically upon firing.

Pope, in his very latest long-range high-veloc-

ity barrels, has rifled them in such a way that the axial sectional area of the bore will equal the axial sectional area of the bullet. This gives a much less distorted base to the bullet than when it is of groove diameter and also does away with

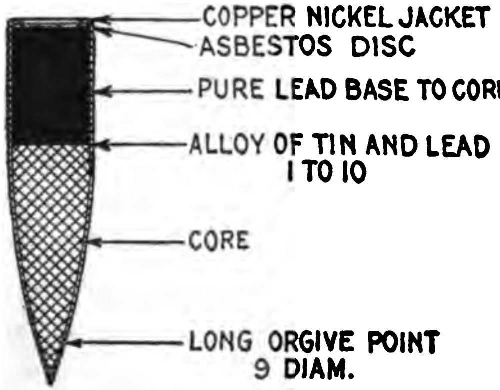


FIGURE 11. 30-CALIBER BULLET WITH EXPANDING BASE

much of the displacement of the jacket caused by the deep engraving of the lands.

A word as to the theory. If we take a bullet of exactly groove diameter and force it through the barrel from breech to muzzle, we displace the amount of metal occupied by the lands and get elongation of our bullet. In as much as the bullet is forced to the muzzle by pressure from the rear, just so much will the base be deformed, leaving a ragged or saw-like edge. Now, once

more referring to the Mann experiments, we find that even marked mutilation of the forward part of the bullet has little or no effect on accuracy, while a very slight deformation of the base, such

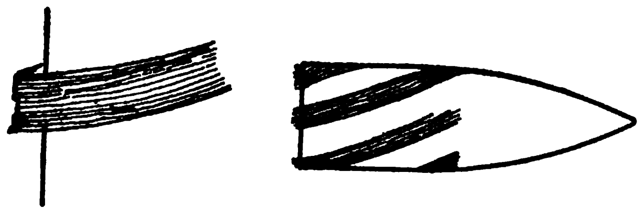


FIGURE 12. BASE OF 30-CALIBER BULLET SHOWING DEFORMATION CAUSED BY LANDS

as filing the almost infinitesimal amount of three grains from one edge of the base, was immediately observed in the groups obtained.

Now, if we force a bullet of axial sectional dimension equal to the bore through the rifle barrel, we will fill the grooves with the metal displaced by the lands, the amount so displaced equaling the difference between the diameter of the bullet and the groove diameter.

Likewise, if we make the driving edges and the back edges of the lands slightly rounded as well as the corners of the grooves, we will facilitate this filling of the rifling by the bullet, while by multiplying the number of lands, we will prevent stripping by increase of torque and so im-

part a more definite twist to the bullet; we also save wear and tear on the barrel; then, too, with this reduction of twist, we obtain increased velocity.

CHAPTER III

TARGET RIFLES

For the target gun, pure and simple, we have a distinctly original type, generally known as the Schuetzen rifle, weighing about 12 to 14 pounds, generally fitted with double set trigger, palm rest, and fine target sights or telescopic sight. Once more we must turn to Pope for almost perfect work in this line. His barrels are generally made with eight grooves and regulated for the 22-short cartridge up to 50 yards. Really wonderful groups have been obtained and the general rule seems to be that for center groups the 22 will give about one-third the accuracy within its range of 50 yards as do the more perfect target weapons of 32/40 and 38/55 caliber. This is truly marvelous considering the almost minute charge of powder in the tiny bullet.

With the 22 long-rifle cartridge of very recent issue we find much to be desired, for with the increase of velocity beyond 1,000 feet per second, we obtain several wild shots with unaccountable

FIGURE 13. 32/40 SCHUETZEN RIFLE, WINCHESTER ACTION, POPE 32-INCH BARREL; WITH THREE GROUPS, ACTUAL SIZE, SHOT WITH THIS RIFLE AT 100 YARDS, MACHINE REST

dispersion out of each group of 20 or more. If the cartridge companies would make a bullet of 45 grains with a velocity of 1,000 feet per second and muzzle energy of 100 foot-pounds, we would have a more stable ballistic coëfficient with really good scoring qualities. The increase of five grains weight of the bullet would allow it to be made of two diameters and a shoulder just back of the ogive head which would act as a target punch and make the shot holes more readily and easily counted.

A brief specification of the modern target rifle is as follows:

Cartridge.—22 short, 3 grains powder, 30-grain lubricated bullet.

Length of barrel.—28 or 30 inches, round No. 3 or 4, no rear sight slot.

Bore.—.2219, depth of grooves .0025, diameter of grooves .2234.

Rifling.—8 grooves, one turn in 25 inches.

Action.—Winchester Single Shot No. 2, heavier pattern.

Trigger.—Double-set Schuetzen.

Trigger guard.—Double spur pattern.

Stock.—Fancy walnut checked; with cheek piece; high comb and pistol grip; Schuetzen pattern, or Swiss butt plate; fore end checked, with detachable adjustable palm rest placed at balance of the gun.

Sights.—Rear, Lyman vernier with wind gauge No. 103, small or Stevens orthoptic disk; front, globe

with peep and aperture disks, interchangeable without wind gauge; telescopic, No. 5-A Winchester with new pattern rear mount graduated in one-half minute reading, base blocks placed on barrel 7.2 inches apart and ground true and level.

Weight.—12 to 14 pounds.

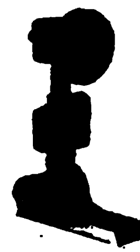


FIGURE 14 (LEFT). LYMAN NO. 103 PEEP REAR SIGHT WITH WIND GAUGE
FIGURE 15 (RIGHT). POPE PEEP REAR SIGHT WITH WIND GAUGE

For use as a mid-range target rifle the specifications apply, save for a barrel of 30 inches in length taking 32/40 or 38/55 cartridge and a more accurate rear Vernier sight of the Soule or Pope pattern, the barrel preferably a No. 4 and hand made by one of our best makers, Pope, Zichang or Petersen. Personally, I consider Pope's barrels unsurpassed, while for the quality of workmanship his prices are very reasonable. It is really marvelous how he can turn out barrels bored to within 1/10,000ths of an inch, as his barrels are in the hands of practically every noted off-hand shot in the United States. With his

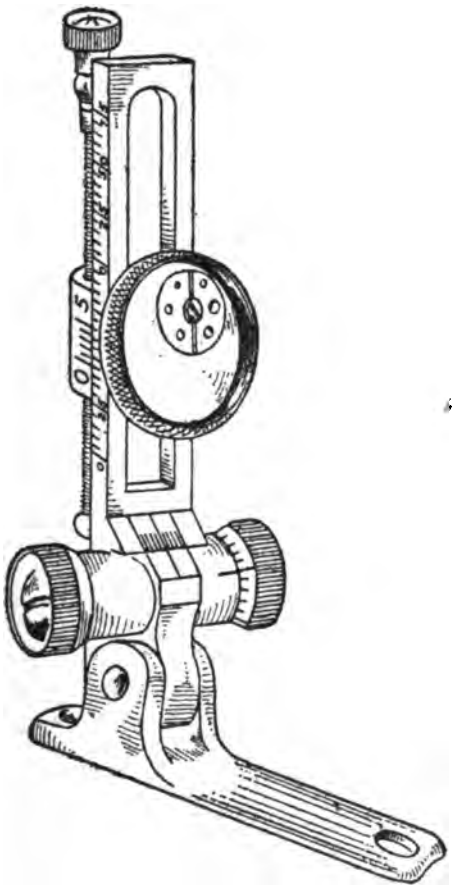


FIGURE 16. SOULE PEEP REAR SIGHT WITH WIND GAUGE

permission I have added as Appendix II a description of his work and methods of rifling which was published by him in 1896, and also his latest

instructions for the use and care of his target barrels.

Mr. Pope has also kindly allowed me to publish a photograph of his famous "Dog Fight Gun," so called from its disreputable looks externally, but with one of the finest 22-caliber barrel borings I have ever seen, and the diagram he has made with it, which speak for its reputation.

Unfortunately really fine and accurate shooting with the rifle at shorter ranges has not flourished of late years, but its place has been taken by 22-caliber practice with the military type of weapon, fostered by and under the management of the National Rifle Association. While this form of shooting has many undoubted advantages, I doubt if its benefits will endure unless very stringent rules are made and enforced in the various matches.

Then, too, there seems to be a desire on the part of certain officials to encourage the number of scores made, and not the quality thereof. It is all very well to shoot a reduced-range course designed to promote the popularity of the sport, but we must remember that in doing so we sacrifice that painstaking care and concentration of effort necessary for really high-class shooting.

FIGURE 18. POPE'S "DOG FIGHT GUN," 22-SHORT, BALLARD ACTION, POPE BARREL, SPECIAL TELESCOPE MOUNTS

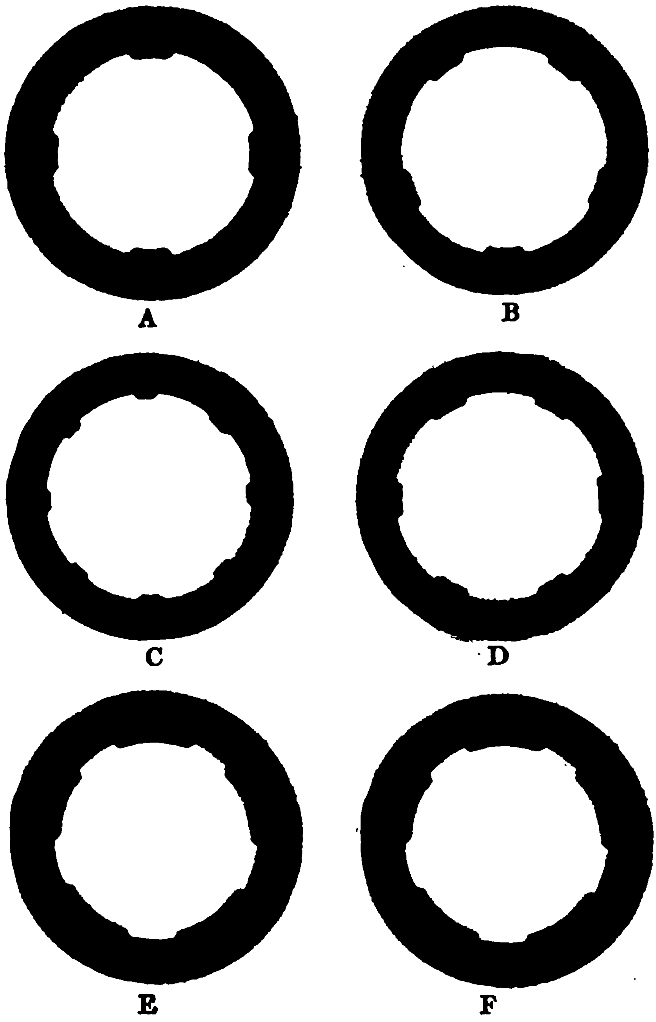


FIGURE 17. TYPES OF RIFLING, 30-CALIBER RIFLES

A, U. S. 1903, four grooves; B, U. S. 1903, Pope, five grooves; C, U. S. 1898, Pope, eight grooves; D, Winchester, six grooves; E, British 1914 Enfield, five grooves; F, German Mauser, 1918, four grooves.

It seems to me that it would be better thoroughly to lay the ground work for future riflemen on quality rather than on quantity, and that by encouraging practice in the standing or offhand position we would get steadier holding and better finger work with the trigger. Very few really high-class shots at the target are successful game shots, and the mission of the 22-caliber rifle is to give a fair understanding of the fundamentals of rifle shooting. It would be of great advantage if galleries could be started and maintained in the larger cities under proper management where instruction could be given to civilians for a nominal charge and where matches could be shot under standard conditions. I doubt if the increase of range in the matches advocated by the National Rifle Association to 200 yards for the 22-caliber will be of benefit. It would seem more practical to limit the range to 50 yards and at that distance to put a premium on accurate shooting. The absolute accuracy of the small cartridge cannot be depended on beyond that range, and with a greater premium on close groups we would develop not only better rifles and cartridges for this caliber, but more accurate holding and care.

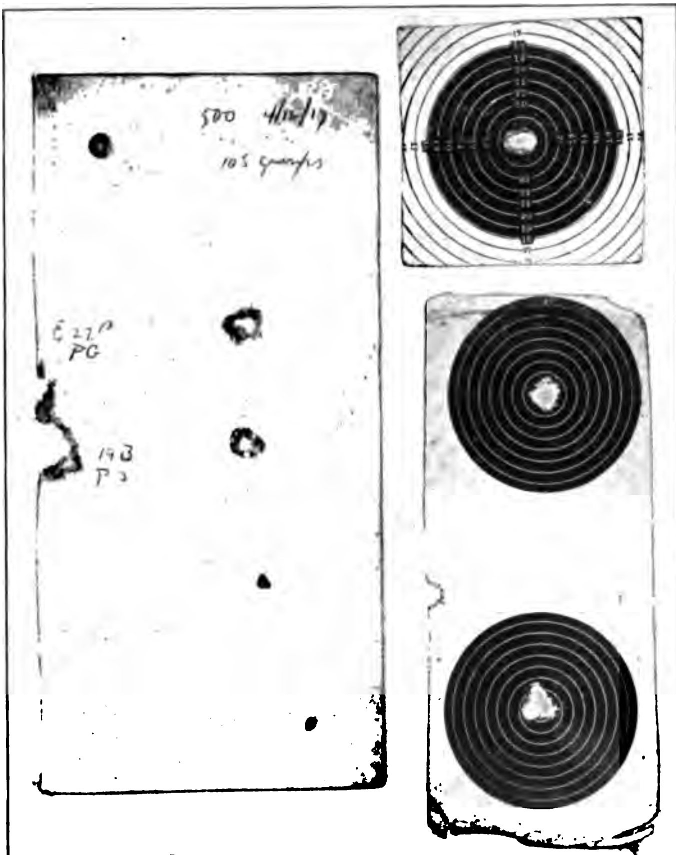


FIGURE 19. GROUPS SHOT BY POPE WITH HIS "DOG FIGHT GUN." REDUCED ONE-HALF

Left, two 10-shot groups, machine rest, at 50 feet, 22-short cartridges. Right, three groups of five shots each, at 50 feet, telescope and rest, 22-short cartridges.

For very fine work the accompanying diagrams (Figure 20) made with a 22-short target rifle will give an idea of the capabilities of this arm.

When we come to the longer ranges of 100 and 200 yards, we find that the group diameters of the 22 are nearly three times as great as those made by the 32/40 and the 38/55, while between the two latter the only advantage with the larger gun is in the diameter of the bullet; the 38 will cut closer to the center but is more difficult to shoot on account of the greater recoil.

While it is not possible for all lovers of rifle shooting to get away after big game, and long range work is necessarily restricted to ranges situated at some distance from our cities, nevertheless, one may indulge in short range 22-caliber work practically anywhere. Also one may practice in 100 and 200 yard shooting with lead bullets in populated areas, as there is little danger of the bullets traveling too far; besides, their penetration is easily stopped with ordinary backing.

Then, too, the cost of ammunition is so very materially reduced as to make it an item, for even with the present high prices, 32/40 loads and bullets will cost less than $12.00 per 1,000 with homemade bullets.

So much can be learned in target work at moderate ranges with lower-velocity cartridges like the above, and at the same time the cost in ammunition minimized, that more should be done to foster this style of shooting. Since the lessons learned on the range can be put into practice against game or in military service, it seems to be worthy of more attention from the powers that be.

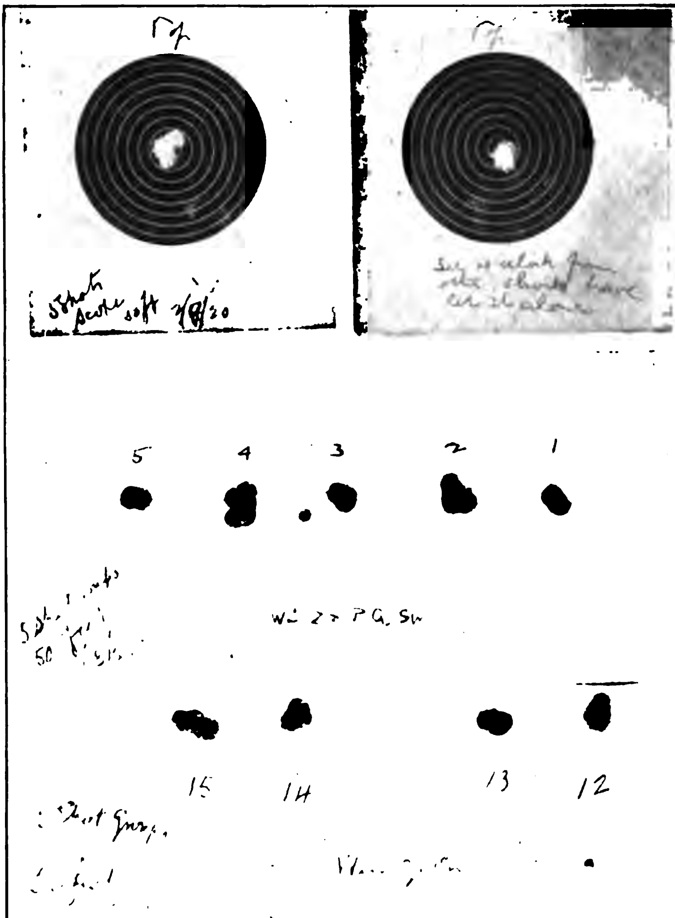


FIGURE 20. GROUPS OF FIVE SHOT AT 50 FEET WITH 22 SHORT TARGET RIFLE, 30-INCH POPE BARREL, BALLARD ACTION, WINCHESTER SPECIAL TETTLER AMMUNITION; REDUCED ONE-HALF

The four lower groups were shot on Saturday, February 6, 1920, and the five middle groups on Monday, February 8, all with machine rest. The two upper targets also were shot on February 8, sighted with telescope. Largest group 5/8 inch in diameter, smallest, 20/100 inch. Groups were consecutive on each day. Six out of the nine lower groups were less than 3/8 inch in diameter; 13, 1, 3, and 5 are the best, and may be taken as the standard of possible excellence.

CHAPTER IV

ACTIONS

The breech mechanism by which the barrel is connected with the stock and the cartridge held in place and the primer exploded, may be divided into three classes:

(1) Falling or sliding block actuated by a lever below the trigger guard. These are generally seen on our American single-shot and repeating rifles.

(2) Bolt actions depending on an interrupted screw thread to force the cartridge forward into the chamber of the barrel.

(3) Snap or spring action which holds the barrel down against the face of the breech by the spring actuated bolt.

The two latter actions are mainly used in military rifles and in double express rifles.

The automatic action actuated either by gas or recoil is not as accurate, owing to the necessity of a loosely fitted cartridge to facilitate its functioning, as either the bolt or lever action, nor is

it as certain, since it is dependent entirely upon a spring to close the breech for firing. Up to the present time it is not considered suitable or dependable enough for game shooting.

The theory that resistance in direct line with the axis of the bore is superior in the development of accuracy has been admirably proved by Dr. Mann in his experiments with concentric action in connection with his V rest. The remarkable showing of nearly all military arms with bolt actions sustains this. The fact remains that all actions, functioned by a lever applied from a different point than that of the axis of the bore, will, upon the action of the exploded cartridge, force back a certain amount against the lever; thus the cartridge will not be held immovable while firing.

Probably the simplest and most effective bolt action ever introduced was the Mauser; our own service gun is simply a Mauser modified by our Ordnance Board.

There is no interrupted screw that can compare in simplicity with the two heavy locking lugs on the bolt head of the Mauser, and no straight pull action can equal the direct force applied by the bolt handle to rotate the bolt and to start the extraction of the fired case. The action is

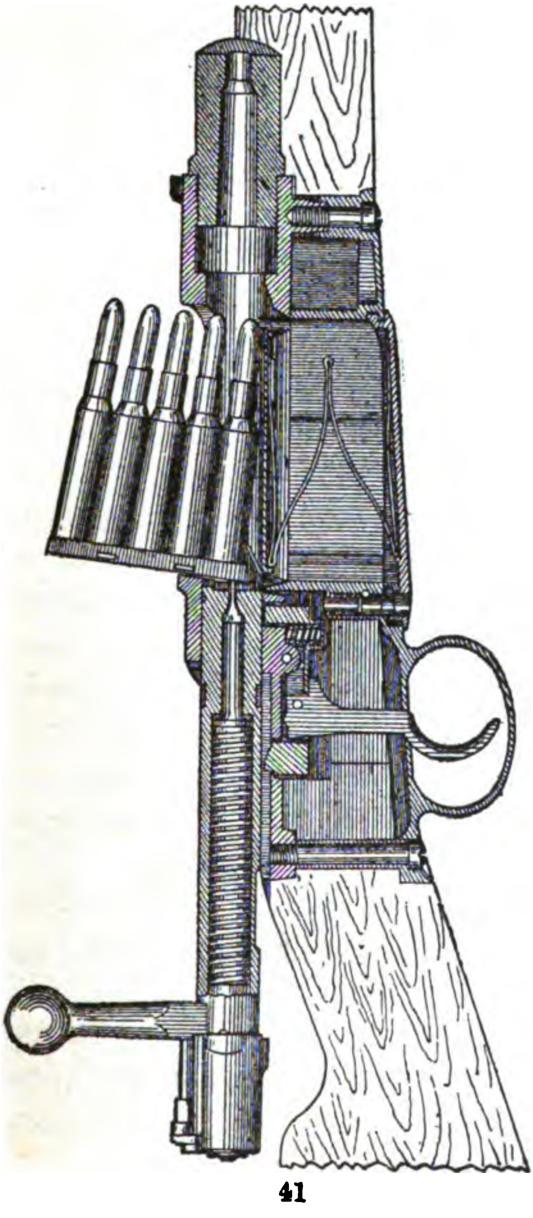


FIGURE 21. MAUSER ACTION, 1895

positive and there are no spiral channels to divert the force applied. The weakest point is the junction of the bolt with the breech end of the barrel, especially with the rimless cartridge, and this requires binding down force strongly applied to force the cartridge home.

It is my opinion that the cone-shaped bolt well at the breech of our Springfield barrel is not so strong as the regular Mauser square shoulder, and with a defective cartridge it is more likely to allow a blow back of gas past the bolt head.

Another point in both Springfield and Mauser actions which might well be improved is the magazine feed plate, which is liable at times to become canted in the magazine well proper and to jam, especially if bullets seated longer than the regulation are used.

In the Springfield we have an elongated firing pin head, useful only to let the firing pin down and to cock by hand, which are methods not even prescribed in our *Manual.*

The value of the cut-off is nil in field work, and I have known many instances of its being accidentally turned down during hasty loading in rapid fire; it might better be made reversed in its action.

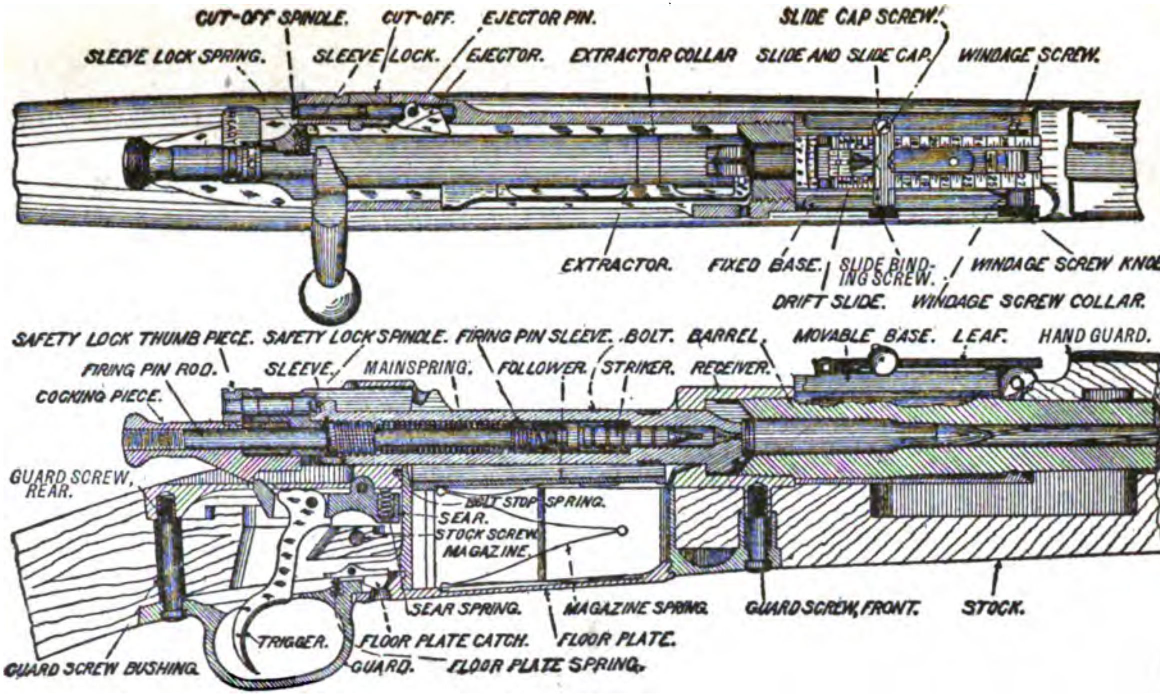


FIGURE 22. ACTION OF U. S. SPRINGFIELD MAGAZINE RIFLE, MODEL 1903 (FROM ORDNANCE MANUAL)

The claims for rapidity of fire advanced for the lever action have not been sustained to any extent; the ordinary man can shoot the bolt action fully as quickly as the lever, and he can shoot both much too quickly for all practical purposes. There is no use in an exhibition of fireworks and no game has yet been killed by noise alone.

The fact that the more firmly and more solidly the cartridge is held in the chamber, and the more homogeneous the barrel and action, just so much more accurate will be the shot, is indisputable. Take the old muzzle loaders; even to-day, with all the improvements, I doubt if a really good weapon of that type is greatly excelled in accuracy by our very best breech loaders. So the nearer we can make breech and barrels one, the surer we are of introducing the bullet to the rifling in a balanced manner with the two axes coincident. The Pope barrels which load from the muzzle practically seat the bullets thus automatically, and, inasmuch as the bullet is already seated with coincident axis in the bore of the rifle, the function of the cartridge is merely to give the impulse to the bullet. No matter how great the advantage of this system for accuracy, it is im-

practicable for field use; so we must trust to the cartridge to hold the bullet in proper position to take the rifling. This, too, is an argument in favor of the bolt action, as the cartridge is merely shoved forward from the top of the magazine, not tilted into the chamber, and so there is less chance of eccentric position of the cartridge; furthermore, the chamber may be made of closer fit than the lever action gun.

This trouble in tilting the cartridge is most noticeable in the 22-caliber, repeating rifles, handling the 22-long-rifle cartridge, which are notably inaccurate in this function and are given to jamming or cutting the point of the bullet against the rear end of the chamber, which is almost entirely absent in the more modern 22-bolt action repeaters with straight feed from magazine to chamber.

The same fault may be found with all lever action repeaters but is not so much in evidence with those having magazines with revolving feed, and, to a certain extent is present with the bolt action guns with a vertical spring feed, but is again reduced in single loading by having a fairly long travel of the bolt, not permitting the extractor to engage the cartridge head firmly until

the cartridge has already been inserted into the chamber.

For the heaviest rifles the old under-lever screw grip is, I think, preferable, as it combines great binding down power on the lugs of the barrel, together with force enough to close the action on a cartridge with a thick head, which, combined with a wedge projection on the extension of the rib against which is forced another wedge, makes the gun practically immovable against even the heaviest charges.

The contention that bolt action rifles are affected by sand or ice is entirely unfounded, for one has only to observe the various military tests to see that under the most trying test, sand and rust, the actions hold up.

As regards safety bolts, there is only one piece of advice for rifles against heavy game. They should be positive and not automatic, for any safety device that must be prepared for each shot only makes one more motion which, in the excitement of the moment, may be overlooked with disastrous results. In regard to the cut-off on repeating rifles, for use in the field, they are not of value and should be turned on and kept so.

As regards trigger pulls each man has his

own idea, but a safe rule is not to have them too light and, for sporting purposes, all drag creep or double pull should be eliminated. Above all, they must be crisp and clean—personally, I find a pull of two to two and one-half pounds about right, while with double rifles the left trigger should pull $1\frac{1}{2}$ to two pounds heavier than the right, both because there is danger of jarring off the second barrel and because with a heavy rifle, after the recoil of the first shot, it is held harder and therefore more force is likely to be expended unknowingly on the trigger.

Purdey has a very good intercepting block actuated by the pull of the trigger of each barrel to cross and intercept the trigger of the barrel not in use. This makes it impossible to fire both barrels at once,—a very good thing to avoid, especially with a heavy elephant rifle.

The triggers themselves should be checked to prevent the finger slipping,—a common occurrence in the tropics through rain, sweat or other causes.

Ejecting mechanism for double rifles is only adding another pair of locks to the gun and is apt to get out of order and needs timing and regulating. The less complicated the action is the more

likely it is not to break down and there is just so much less repair. The speed of loading hardly counts as one generally uses two guns against the heaviest game.

Another hint with heavy rifles: Have the rear end of the forward sling lug slanted. This will prevent the recoil cutting the forefinger of left hand. For the same reason the tang portion of the trigger guard should be well sloped to the rear to prevent cutting the middle finger of the right hand on recoil.

CHAPTER V

STOCKS

Undoubtedly the very best wood for gun or rifle stocks is that known as English or Circassian walnut. It is difficult to obtain really good blocks with suitable grain. The American black walnut, with plain straight grain is very good and tough but in the varieties showing fine figure is apt to be too heavy, while the Italian species is shorter in the grain and still heavier.

The grain of a stock should run very straight through the small of the stock, as a cross grain is likely to split and break easily. The accompanying figure of a block will illustrate what is required as to grain.

It is a good plan to have your gun maker smooth and oil one or both sides of the blocks from which you choose your stock, as the character of the wood is more clearly seen.

The wood blocks should be thoroughly seasoned and it is well to oil them from time to time. Any blocks with shakes or cracks should be discarded.

Before having the stock made, one should be fitted by a try gun with adjustable comb, heel plate and small of stock, and the rough measure-

FIGURE 23. BLOCK FOR STOCK SHOWING STRAIGHT GRAIN

ments taken. It is of the greatest importance, especially for heavy rifles, for use against dangerous game, that the weapon should come up with

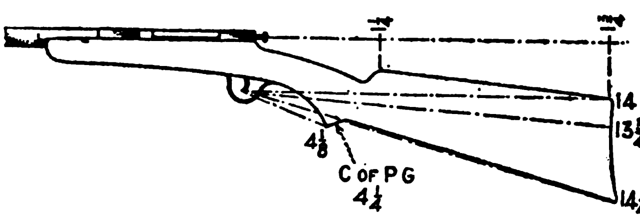


FIGURE 24. STOCK MEASUREMENTS

the sights in line with the eye, for it will make a quick shot easier and will not force the shooter to move his head to locate the front sight in the center of the rear. The rough measurements for a sporting stock of a Springfield rifle to be used

by an average man of, say, 5 feet, 10 inch height, are as follows:

From trigger to center of butt, 13¾ inches.
From trigger to toe of butt, 14¼ inches.
From trigger to heel of butt, 14 inches.
Drop from axis of bore to heel of butt, 1¾ inches.
Drop from axis of bore to comb of stock, 1¼ inches.
Circumference of pistol grip at smallest part, 4 to 4¼ inches.
Length from trigger to inside of pistol grip cap, 4⅛ inches.
The pistol grip should be well curved and not too short, as are most of our rifle models.
The cast off or bend of stock from axis of bore to vertical center of butt at heel, ¼ inch; at toe, ⅜ inch.
The inside of butt should be well rounded or chamfered to conform with the slope of the chest muscles.

I purposely use as the standard of measurement the axis of the bore, as it is very easily determined by running a patch through the bore to the muzzle on a steel cleaning rod and allowing the butt of the rod to extend back from the breech. As to the use of cheek piece on the stock, I can see no real necessity for it if the comb is properly made to fit the shooter's face,—possibly it may be of advantage if the shooter has a very long and thin face.

The question of butt plate is, I think, best answered by the use to which the rifle is to be put.

If it is to serve as a walking cane, alpenstock or support for a tent, then have it of steel, by all means—and solid likewise—but if the gun is to be used to shoot with, a solid butt plate of thin steel fulfills all requirements. In the case of heavy rifles a rubber recoil butt is usually fitted and this undoubtedly saves the shoulder in snap shots when the rifle is not placed in the right spot. As to the hollow butt plate, with trap and recess for cleaning rod, they are worse than useless, allowing water to get not only to the implements carried, but to the interior of the stock—besides, there is usually a rattle of the loose contraptions in the butt. If spare parts have to be carried in the rifle, the best place I know of is to have a hole bored *under* the butt plate, just fitting the spares; then wrap them in wax paper and fill the cavity with a stiff mixture of beeswax and tallow and replace the butt plate. This plan is especially good for spare front sights of which two should be carried with their pins under the pistol grip cap. Your gun-bearers and boys will not then be tempted to take them out and probably lose them.

As regards the shape of the butt, it should be coarsely checked and shaped to the shoulder with

sufficient curve in the center to keep the rifle from slipping down.

The checking of the pistol grip and fore-hand should be as small as possible and yet give a firm grasp. The diamond-top shallow check is undoubtedly the neatest, but it is a very difficult method of checking; the smaller checker of the pattern usually seen on Winchester rifles fulfills all requirements. The plainer and smaller the amount of cutting on the exterior of the stock the better. Stocks should be well soaked in oil before they are finally finished, and it is a good plan to have your gun maker submit the gun for your inspection and trial before the checking is done. Any small alterations may be made at that time. When the barrel and action are fitted, it is a good plan to have the edges of the metal and interior of the stock coated with beeswax,—thus insuring a waterproof joint.

As to the use of slings on a sporting rifle, they are generally employed for purposes of carrying and very rarely for shooting, unless for long and deliberate shots. For this reason, the military sling with double loops is merely a useless amount of leather. A plain single strap attached by studs to the loops on the rifle, with

buckle to regulate it, is best. The best mode of employment is to hold rifle, sights up, by small of stock in right hand, sling loose, pass left arm through space between rifle and sling to the right; then under sling strap to left and grasp rifle at fore end.

If the length of strap is properly regulated, this will give all the support necessary and at the same time can be quickly disengaged. The use of loops

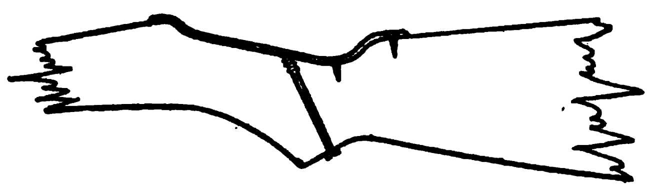


FIGURE 25. SCREW FROM CAP OF PISTOL GRIP TO TANG STRAP TO STRENGTHEN SMALL OF THE STOCK

on the stock and either fore-end or barrel is advisable, as they cause no rattle. The sling strap should be broad—not less than one inch wide—so that it will not cut the arm or shoulder when in use.

A good method of strengthening the stock considerably at its weakest point, the grip, is to have the tang of the action made long enough to extend to the rear over the top of the comb and have the screw of the cap of the pistol grip made long

enough to screw upwards through the stock into the tang. Newton rifles have this feature, as do also many English expresses intended for rough work.

The section of the pistol grip should be slightly diamond or egg-shaped to prevent the rotating of the gun in the hand.

CHAPTER VI

SIGHTS

The object of sights is to enable the rifleman to point the barrel in a proper direction to hit the object aimed at. Furthermore, by a change both laterally and vertically, he may allow for the variation of the compound curve of trajectory caused by gravity and wind.

Therefore, the essentials of the sights are that they may be raised or lowered, and moved to either side a definite amount to allow for such variations. This adjustment is generally made on rear sight.

The rear sight is usually made in one of two forms, open or peep, while the front sight ordinarily in two; but, admitting of three, there may be post, aperture, and globe.

If we take the rear open sight, we may again divide it into two forms, the bar and V, which may be combined or simple. Now as to the merits of these forms, there are many advocates for each, but the combinations are so great that, when

all is said and done, we may as well confine our remarks to the simpler ones (see Figure 26).

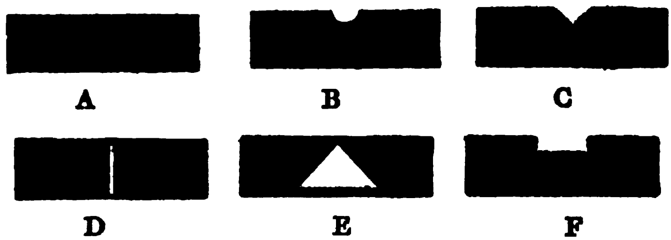


FIGURE 26. TYPES OF BAR SIGHTS

A. Simplest form straight bar. Difficulty in finding exact center.

B. Bar with U indicating center. Better than A but unreliable, unless used in conjunction with a bead or globe front sight.

C. Bar with V indicating center. Should be used with barleycorn front sight.

D. With inlaid line of light-colored metal or ivory. Should be used with an ivory or gold bead front sight.

E. With one-half diamond of light metal or ivory. Should be used preferably with a coarse ivory bead or Jack front sight.

F. With square notch to be used with a square top sight of proper dimensions.

Now A, D, and E are of the same base and form; the advantages of D and E rest in the fact

that the lines indicate the center of bar. B, C, and F have the center of the bar plainly marked, but with B and C it would be difficult to center the front sight exactly in the notch. Taking the simplest form of front sight, a post, with B we

H I

FIGURE 27. BAD COMBINATIONS OF SIGHTS

have H, the judgment of exact center dependent upon the accurate judgment of the two segments and a rectangle, rather difficult on account of curves and hard to keep vertically perfect.

With C, we have the judgment of two triangles and a rectangle, I, open to the same objections as B. With F, we have the judgment of two rectangles, J, which is simpler, especially if we have

J K L

FIGURE 28. GOOD COMBINATIONS OF SIGHTS

the square notch made three times the apparent width of the front sight, for we then can compare three equal rectangles and be reasonably certain of getting the same elevation and lateral each time. Likewise, if we should employ with

rear sight C a front sight similar to the barleycorn on English service rifles, we will have three triangles to compare, K, or three similar figures; if with rear B sight we use a globe or pin-head front

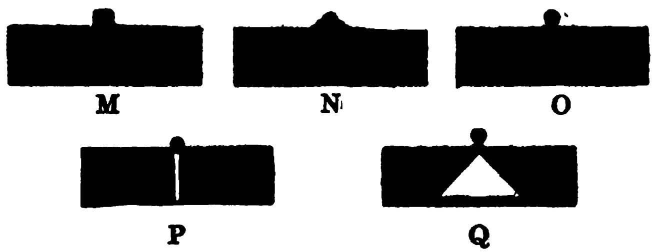


FIGURE 29. UNDESIRABLE COMBINATIONS OF SIGHTS

sight, we obtain L, a semi-circle above the bar, and by seeing a very thin rim of white between the globe and the bottom of the U, keep a definite amount of front sight. Use any of these

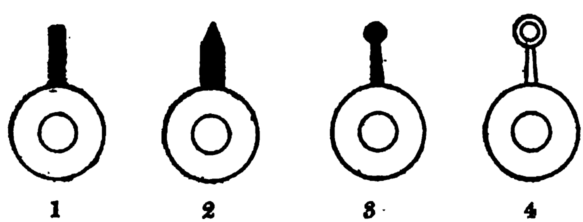


FIGURE 30. FRONT OPEN SIGHTS IN GENERAL USE: 1, POST; 2, BARLEYCORN; 3, BEAD; 4, APERTURE

three front sights with the plain bar A, or its modified forms D and E, in which case we will have the combinations shown in Figure 29, all of which are untrustworthy unless we have the cen-

ter defined as in forms D and E. And even then we cannot be sure of taking the same amount of front sight each time, unless we use the globe shape.

FIGURE 31. FRONT GLOBE TARGET SIGHT, WITH SPARE DISK

These diagrams show conclusively, I think, that the shape of the front sight must be a complement of the center mark in the rear sight, and that we must have some definite means of gauging the amount of front sight taken each time. If we have a bar sight with square notch or aperture, three times the apparent width of the square-topped front sight, we can get our proper vertical and lateral allowance nearly every time. Add to this that if we make the front sight the apparent width of eight inches at 200 yards, and the depth of the notch the same, we will have our data as follows on regulation 200-yard targets:

Apparent size of man's head at 200 yards, 8 inches; width of shoulders at 200 yards, 24 inches; width of front sight = 1 point, 8 inches of Springfield, wind at 200 = 8 inches elevation,

which gives us a great many comparative standards to help our allowances in shooting, this then resolving itself into merely the judgment of three rectangles of the same size on each side.

FIGURE 32. PROPERLY PROPORTIONED SQUARE-TOPPED FRONT SIGHT WITH SQUARE REAR NOTCH

It will therefore be evident that the bar sight must have some indication of its center and that the most practical shape for the indication is a square notch used in conjunction with a square-topped post front sight, for all target shooting. The objection to this sight is that the bar rear sight obscures the major portion of the object aimed at, leaving only the exact spot desired to hit exposed; and the difficulty of seeing the front sight against a black or dark object. Therefore, for hunting purposes, the ivory bead front sight with bar rear and U notch will be found best. So much for the bar sight. The main objection is the difficulty of quickly finding the center of the bar and the impossibility of getting good definition of a dark colored front sight when used against a dark background.

The alternative form of open rear sight is the V. This may be merely an indication of the center of the bar as in C, or it may extend the whole width of the bar. The wider and shallower the

FIGURE 33. FORMS OF V REAR SIGHTS FOR EXPRESS RIFLES

V, the more difficulty of accurately placing the front sight in the center of the notch, and so we usually find the rear V sight provided with a platinum or ivory line to help in this respect. The regulation English express sight, as furnished by the best gun makers, is a V used with a bead front sight with platinum tip.

I think that one must find out for himself the color of front sight most easily distinguished against a neutral colored background in a bad light and adopt that for his hunting use. In England, with military front sights, it is customary on target work to touch the very tip of the smoked front sight with either chalk or white paint. This, however, necessitates holding into the black of the bull, which is not considered good practice here.

My own favorite open sights in the field are a broad shallow V with a U notch in the bottom

of the angle, a gold vertical line from the bottom of the U to the barrel, used in conjunction with a gold bead front sight of small diameter.

FIGURE 34. AUTHOR'S FAVORITE SIGHT

This combination enables one to quickly find the center of the rear sight and to draw the bead closely into the bottom of the U. It shows well in jungle or on open ground, and is sufficiently accurate for short ranges where either small or no allowance need be made laterally, which is all that is required of a sight when used on heavy express rifles where one cannot use the aperture or peep sight on account of recoil.

We now come to the consideration of the peep sight. This is far more accurate for use with all rifles except very heavily loaded expresses.

The two functions performed by this sight are, first, to act as an orthoptic and cut out all excessive and superfluous light; and secondly, to act as a circular opening through which to align the front sight and objective. The limitations as to size are, on one hand, the obscuring of the vision by the cutting off of light or lack of illumination; on the other, the enlarging of the aperture

beyond the point at which the center of illumination is distinctly perceptible.

It may be taken as a general rule that subject to the two above limitations, the nearer the eye the sight is placed, the more readily can it be used. Here, too, we have a limit. The aperture cannot be close enough to the eye to injure it in case

FIGURE 35. TARGET SIGHT SHOWING CONCENTRIC CIRCLES

of recoil and we must therefore have enough relief to insure safety.

Now, inasmuch as we start with the circle, we should theoretically continue our sight in the same form. This is the best illustrated in the very accurate target sight used on match rifles in which we have circular bull, circular-aperture front sight, and circular rear peep sight. Thus we have probably the most accurate form of rifle sight known—five concentric circles.

Still, as we cannot always shoot at a circular mark, we must therefore do away with one of our indicators, and when we do this we find that unless we have the objective very clearly defined it is extremely difficult to place on it the exact center of the ring front sight, so we must perforce reduce the size of the front sight and make it solid; then we can easily place the globe on the objective, preserving, however, the circular form of front sight tip. This tip may again be made of some different material than the stem, to show up more readily against a dark objective; it is generally either of ivory, platinum or gold. Here again the shooter must decide for himself which color or substance gives the best definition.

In the case of military rifles the front sight is made with a square top which is obviously inferior to the circular bead for game shooting, inasmuch as it eliminates the advantage of concentric circles. We now come to the proper size of aperture and it may be taken for granted that the smaller the aperture, the more accurate the sight; but we again run against limitations. We must not make the aperture small enough to cut the proper illumination of front sight and objective. This, too, the shooter must decide for himself, re-

membering that the smaller the aperture the more time it will take to find the front sight, for we lose sight of the objective and front sight while the circumference of the rear sight intervenes during the act of aligning the sights.

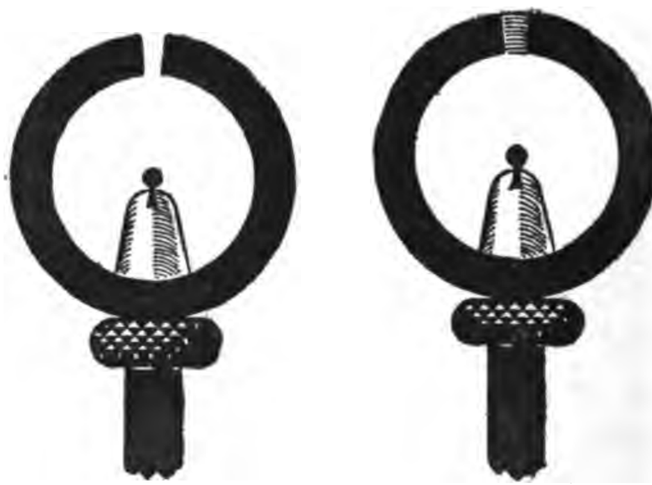


FIGURE 36. LYMAN REAR PEEP SIGHT WITH CUT RING

This may be overcome to a degree by cutting the periphery of the rear sight in the shape of a very narrow V, which enables the shooter to see the object at which he is aiming and the front sight all the time, until they are both centered at the point of greatest illumination, the center of the aperture of the rear sight. Now this cut in the ring of the rear sight will not interfere with the circular effect, inasmuch as when the eye is

focussed on the objective and the front sight, the rear sight being then out of focus, the narrow V cut will blur or gray over and will still give the circular effect. The illumination is also much greater and snap shots at dusk are rendered possible.

One fact must be remembered and cannot be too strongly emphasized. The shooter *must* look *through* the aperture of the rear sight as through a window. He will find that the front sight will be most clearly seen at the point of greatest illumination, the center of the rear sight aperture, as will the objective. For all practical purposes of hunting the large aperture of the Lyman sight 3/32 inches in diameter, placed at a distance of not more than 5½ inches from the eye, will be found about right.

Another factor in accuracy should not be disregarded, and that is that the greater the distance of sight radius the more accurate the aim.

As to lateral adjustment, most modern aperture rear sights have a means of so doing with micrometer scales, while the open rear sights are usually dove-tailed into a slot traverse to the bore and may be driven to the right or left, care being taken not to mar or injure the sight.

Many have a combination of three sights on the rifle—front sight, open rear sight and aperture rear sight. The open sight is unnecessary if the aperture rear sight is used and should only be employed in case the rear sight is broken or bent. If it is placed on the rifle at all it should fold down flat on the barrel below the line of sight.

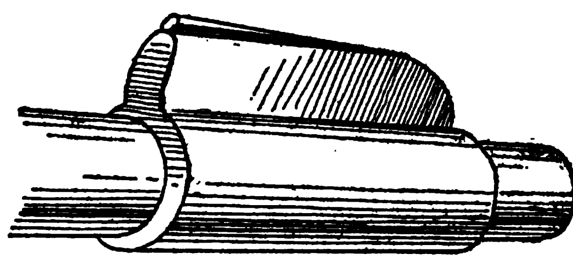


FIGURE 37. FRONT BEAD SIGHT SHOWING RELIEF OR SLANT OF 10 DEGREES ON BEAD

As to the form of front sight face, it will generally be found that the reversed cone filed at an angle of about 10° on the top will show best in bad lights. This will present the greatest surface section to the eye and will prevent the radiation of light at the edge of the sight.

One must also remember that the edges of the rear sight aperture or the edge of the open sight should be beveled towards the muzzle, to leave a sharp edge for clear definition, without halation, next the eye. My own favorite rear sight for use

with the U. S. Rifle 1906, 30-caliber, sporting stock, is the Lyman 48 Receiver sight with cut large ring and spare disk for target use, with a Sheard 1/32 gold-bead front sight.

FIGURE 38. LYMAN NO. 48 REAR PEEP SIGHT FOR SPRINGFIELD

All front sights should be provided with a protector of some sort for they are exposed to many a rough knock in the field, and it will save a bent sight and a broken ivory or gold bead.

The pattern of sight protector issued on our service rifle is good and the rifle may be used with the cover in place in emergency.

The leather stalking muzzles seen on most best-quality English game rifles, while they protect the sight and prevent the muzzle from knocks or becoming plugged with dirt or snow, are always in the way and one cannot shoot until they have

been removed, besides adding the risk of a bulged or burst barrel if the rifle is fired with the protector in place.

Peep sights mounted on the rear end of bolt or cocking piece are not so reliable as those fixed solidly on the frame or receiver.

I have never known one mounted on the bolt to stay put for any length of time; since there must be movement and a certain amount of play in the bolt, there is of necessity some in the position of the sight. Then, too, I have known the aperture to be lost through the sleeve rotating on a gun-bearer's shoulder.

It will be seen that the ease of aiming accurately is dependent on the length of sight radius, for if we could prolong the barrel to the objective, there would be no trouble in placing our shot where we wished. This, of course, is impossible, so we must get the longest possible distance between front and rear sights, with solid foundation for the sights.

Now, it will generally be found with open sights, that the further from the eye the rear notch, the more clearly will both front and rear sights focus, which, of course, means a short sight radius; while with peep sight the nearer the eye

the aperture, the more readily will the shooter accommodate himself to the theory of looking through the sight as through a window, and the longer and more accurate will be the sight radius.

I strongly recommend the use of the peep sight with relief enough to insure safety to the eye on all save the very heaviest rifles, which are used at short range, where the tremendous recoil makes it dangerous to use the peep sight mounted on the tang.

Luminous and Night Sights

Very little satisfaction can be derived from night shooting. One is not only at a disadvantage in seeing the game, but even with the best appliances and sights, one cannot be sure of hitting the animal in the right place. Furthermore, it is extremely unsportsmanlike to have wounded game about, and with the case of dangerous game it may cost some poor devil of a porter his life or at least give him a severe mauling.

An instance of the danger of wounded game not followed up and killed is as follows: Three men of my acquaintance were shooting on the Tana River, British East Africa, some years ago. One of the party wounded a rhino, which ran

into a thick clump of thorn bushes, and foolishly left him. Toward evening another member of the party not knowing of the wounded animal saw a rhino standing under a tree. He fired at the animal and failed to kill it. Unfortunately the rhino did not act in the orthodox manner and make a straight charge, but chased him as a cat would a mouse. His gun-bearer bolted and kept firing the second gun at the animal, but of course, not hitting it, for natives are notoriously bad shots. My friend said one or two bullets came dangerously near him. As there was no time to reload, he dropped his rifle and started to run in a circle, trusting to the tales of a rhino's poor eyesight. But this did not work, for every time he turned the rhino did likewise. The finish I heard from Cunninghame, who was in charge of the Safari:

I heard a great bombardment going on a short distance from camp, when one of the porters came running up and said the Bwana was being killed by a rhino. So I grabbed my 450 and went over the rise and saw X some few yards in advance of the beast. Every time he turned the rhino did also, and in the distance was a wild

gun-bearer waving his arms and giving advice to the Bwana who, when he could find a breath, cursed him, the bearer. I put a stop to the show with a neck shot as the rhino passed me.

X was pretty badly winded and worried, and to this day swears he could feel the horn of the rhino behind him. Of course, the gun-bearer got Kiboko. This only serves to show what may happen in broad daylight.

My advice to all sportsmen in regard to night shooting is "Don't try it," but if it is necessary, these are one or two dodges which may prove useful.

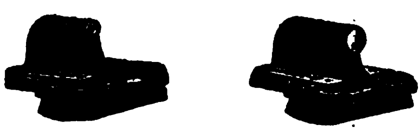


FIGURE 39. GLOAMING OR NIGHT SIGHTS

I have found all luminous sights and head lights worthless. At night a large white bead front sight, which may be slipped over the ordinary one, or which turns up, as in the Gloaming sight, is fairly visible if a large Lyman aperture rear sight be used. When it becomes too dark to see that, a narrow strip of adhesive plaster, well chalked and fastened to the rib of the barrels or to the

barrel itself, will catch all reflected rays and will give a good general idea of the direction of the gun for close shots.

Jack lights and electric flash lights are useless. If you must shoot after dark, a white magnesium flare or Costen light ignited by a cap and held in a torch handle or signal pistol will illuminate the nearer objects for sufficient time to see to shoot. Remember always to have your gun-bearer hold the flare back of you and above your head. You will then see not only what you are shooting at but your sights as well.

Telescopic sights are practically useless in the field. In the first place the mountings are delicate and the proper adjustment takes time, which is impossible unless a very deliberate shot is at hand.

True, the objective is enlarged, but so are all intervening objects. Then, too, the illumination is cut down if the scope be of any power over three diameters, and unless the field or portion of the landscape covered by the glass be large, one is constantly losing the objective and having to re-sight.

Take the records of long range shooting here in America, and we find that under all conditions

of weather, light, etc., plain iron sights have always beaten out the telescopic ones. The exception is, I believe, in the Wimbledon Cup Match, which was won twice with telescopic sights. This match is 20 shots at 1,000 yards, and if there were any great advantage in magnifying sights, more would have been successful in the 80 odd years of competition.

Another very good instance where the telescopic sight did not make good was in the Herrick Trophy Match, 1909, at Camp Perry, Ohio. The conditions were: Teams of eight men—firing 15 shots each at 800, 900, and 1,000 yards—same conditions as the Elcho Shield Match in England.

There were some 60 teams entered and as any rifle, any ammunition, and any sights were permitted, it was a good test of accuracy of material.

At the final stage of the match, 1,000 yards—about 5 P. M., most of the teams had finished their scores, when a rather difficult condition of mirage occurred.

The Ohio team, shooting special Krag barrels made by Winchester with Vernier sights and special ammunition with the 190-grain bullet, fin-

ished with a score of 1,696 points. The Marine Corps team, shooting U. S. '06 Springfield rifles fitted with *full length scopes* and using the 180-grain bullet, made 1,694 points.

The Massachusetts team had not finished. There were still 24 minutes left for the time limit of the match. I was between two of my men, Captain Allen and Sergeant Kean, both good shots, when I saw through my coaching scope—a glass of 50 power—the mirage dance and boil in a difficult way at the targets, and both scored high threes. I told both men to wait and not to look towards the targets. Minute after minute passed until only 12 minutes were left for the 14 final shots. Suddenly the mirage lifted and almost perfect conditions prevailed, when I told both men to raise their sights slightly and to fire. The result was a wonderful finish, 12 bulls in the 14 remaining shots, in 10 minutes, making a score of 1,700 out of 1,800 and winning the match. The Massachusetts team used service rifles and the 150-grain service cartridge, with service sights as issued.

This at that time constituted, I believe, a world's record for the distances with the service gun *and ammunition.* Of course, the men were

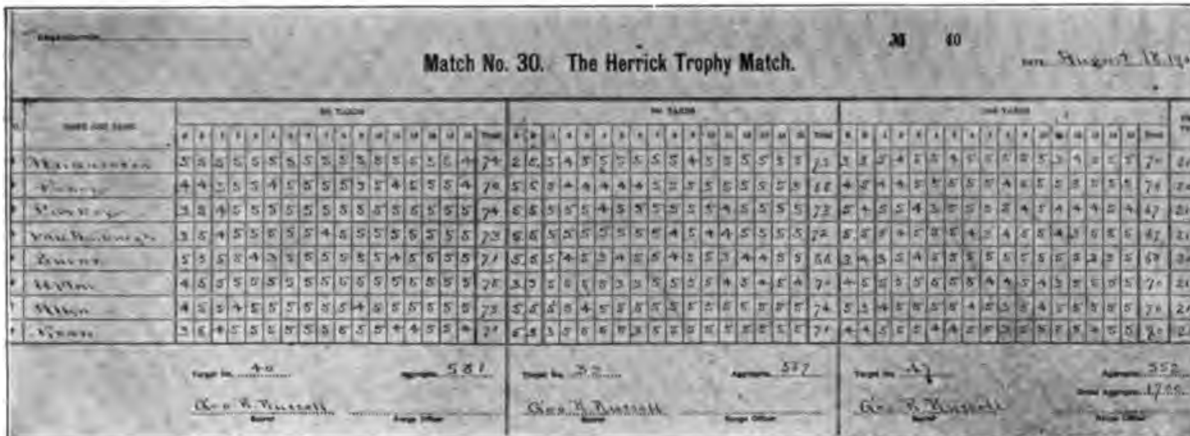


FIGURE 40. ORIGINAL SCORE CARD OF MASSACHUSETTS TEAM IN HERRICK TROPHY MATCH, CAMP PERRY, OHIO, 1909

wonderfully steady shots, and had been well coached during the previous practice. But it goes to show that even under the very conditions claimed to be favorable to telescopic sights the iron sights showed marked superiority.

In discussing the match with Captain Harlee, the Marine Corps team captain, and with Captain Shaw, the captain of the Army team, Captain Harlee said that his men had been bothered by the flow of mirage seen plainly through the individual scopes, and had been made nervous and over-anxious, allowing too much for the conditions prevailing.

The above two records should be evidence enough that the telescopic sight, in its present state of imperfection, is not of any great advantage even at long range.

But we do find that for testing ammunition at shorter ranges where the elements do not play such a prominent part and where the target is more distinct, the telescope is of great advantage, enabling the shooter to hold in exactly the same place each time. This also applies to off-hand shooting at 100 and 200 yards.

The use of iron sights, after one has been using a telescope, seems easy, as the error in holding

with telescopic sights is magnified by the power of the telescope and the ordinary sights seem to stand perfectly still.

The other disadvantage, with a telescope, is that unless the barrel of the rifle is covered by some insulation the halation of heat therefrom causes a boil in the field of vision similar to mirage and often causes very erratic shooting especially in winter, when the rifle is taken from a warm room and shot in the open air. This, of course, is easily avoided by covering the forward part of the barrel with thin asbestos paper and wrapping with insulating rubber tape.

At present there is no really satisfactory scope readily procurable. Probably the best commercial telescopic sight is the Winchester 5 A with new-pattern rear and old-pattern front mounts. The base blocks, which are permanently attached to the barrel, should be placed as far apart as the action of the rifle will allow, and a scale made of elevations necessary to raise the shot one inch at 100 yards should be placed on the micrometer mounts. If the blocks are placed 7.2 apart, the micrometer elevator for the rear sight will read one-half inch for each 100 yards range, as it is divided in .005 inch graduations.

There is always trouble in the solid attachment of the telescope to the barrel, and this has been partially overcome by the dove-tail taper base advocated by the late F. W. Mann, which has this disadvantage, however, that the removal of the glass necessitates pounding the delicate mounts to the rear with a mallet and wooden block. Pope has made a distinct advance in his method of mounting by doing away with all intervening blocks and clamping the front and rear scope mounts proper to slots cut on either side of the barrel; but this necessitates really fine work in machining and cutting the slots and the adjustment of the mounts. Telescope in Figure 19 is so mounted.

The best reticules for use with the telescope at ordinary targets are the single cross hairs as fine as can be made for fine shooting and the post or pin head, if practicing, for holding with either military or match, iron sights.

The targets generally used with the cross hair sight consist of four target pasters two inches in diameter, placed at a distance of two inches apart on a white background to form a rectangle, while for the post or pin head reticule the ordinary circular bulls-eye reduced is used.

Prismatic telescope sights are too heavy and are apt to be jarred out of adjustment by the recoil of the rifle, especially those with movable cross hairs, and their mounts are extremely difficult to attach.

Many of the telescopes, made by Sidle, Malcolm, McQueen, and Mogg were full-length glasses extending the whole length of the rifle barrel and extremely cumbersome. The best scope I have known was one made by Smith of Springfield. It was some 12 inches long, three-quarters of an inch in diameter, magnifications of 10, with extremely fine cross hairs and wonderful illumination, in fact, very perfect optically, and was mounted in rigid front mount, with adjustable rear mount with micrometer readings, both vertically and laterally.

After having used telescopic sights for many years, my conclusion with regard to them is this:

For all ordinary sporting purposes they are worthless, but may be found extremely useful in training to hold steadily at short ranges.

They are expensive and delicate instruments with complicated mounts and adjustments and are entirely out of place for rough work in jungle or forest—fit only for range work and deliberate shots.

CHAPTER VII

CLEANING

Residue in rifle barrels may be divided into two classes, that left by the bullet and the fouling left by the combustion of the powder charge and the primer. I do not include rust, which should never be present.

In the case of black powder with rifles using lead bullets, the easiest method is to clean thoroughly with hot water and soda on a stiff bristle brush or a solution of strong soap and hot water. Dry the bore thoroughly, and if no lead is present, give a good coating with some heavy grease such as Corol, heavy gas-engine cylinder oil, or cosmoline. If, however, lead is present, we must resort to chemical means to remove it, and the best way is to apply mercury. Mercury forms an amalgam with the lead, which in turn is readily removed from the barrel with a stiff brush or a tight-fitting swab.

The methods of applying mercury in use are to plug the muzzle of the barrel with a tight-fitting

cork, pour a small amount of quicksilver into the bore, then plug the breech and roll the mercury up and down the barrel until the lead is amalgamated. The mercury may be cleaned by straining through chamois skin under pressure and used again. Still another way is to coat the bore with strong mercurial ointment which will form the amalgam; at the same time it is one of the best rust preventives known, and may be left in the bore until the rifle is used again, when it should be thoroughly wiped out, the lead coming with it. Probably the very best mercurial preparation is a mixture of mercury and sodium amalgam sold by various dealers under various names. It may be obtained from H. M. Pope, 18 Morris Street, Jersey City, and is called by him "Lead Off." Hoppe Nitro Solvent No. 9 may also be used to clean the powder residue, but it will not remove lead as well or as quickly as mercury.

With high-power smokeless rifles using a metal-jacketed bullet, we are confronted in our cleaning problem, however, with a very different condition of affairs.

The powder residue is composed of carbon and a sticky varnish-like substance of great tenacity,

over which residue is smeared a thin covering of the metal composing the jacket of the bullet, generally an alloy of copper and nickel known as cupro nickel. This metal fouling will resist all efforts of ordinary oils and must be chemically dissolved or the action of the powder residue beneath, which is slightly acid, due to the nitrated cotton or cellulose, combined with that of the primer which is very corrosive, will set up more or less galvanic action and attack the steel of the barrel. Now the simplest solvent of copper is ammonia; so we apply a solution of ammonia and its salt to the bore, and when chemical action has dissolved the copper overlying the powder residue, we pour the ammonia out, thoroughly clean the barrels with a chemical to neutralize the action of the ammonia on the steel, and proceed to remove the underlying powder fouling with another solution of oils and the higher ethyls. When the work is done, the barrel may safely be left without other protection than a heavy neutral oil to prevent atmospheric action. This sounds rather a formidable process, but in reality it takes but a short time, some 30 minutes, to complete. The following is the best ammonia solution I know of:

Ammonia persulphate	100 grains
Ammonia carbonate	50 grains
Ammonia bichromate	10 grains
Stronger ammonia 26%	1½ ounces
Water	½ ounce

The three chemicals should be powdered thoroughly, the ammonia and water then added and placed in a tightly corked bottle until needed. The above solution should not be kept over 24 hours, as the ammonia gas escapes and the resulting solution will then attack steel and not dissolve the copper readily, although the use of ammonia bichromate partially stops the action on steel.

The best neutralizing agent to remove the traces of ammonia from the bore is soda and water or hot water and soap.

The powder solvent consists of oil mixed with either amyl or acetone, or both, and may be made as follows:

Kerosene oil free from acid........	1 ounce
Refined neatsfoot or Rangoon oil ..	2 ounces
Spirits turpentine	1 ounce
Amyl	1 ounce
Acetone	1 ounce

Hoppe's solvent mentioned is practically the same as the above; it is sold at all gun stores ready for use, and is thoroughly reliable. Corol

is a Swiss petroleum jelly of good consistency and is used for protective coating. Vaseline free from acid and not refined is also a good rust preventive, but not so good as mercurial ointment, though cleaner to use. Pope was first to use the ammonia cleaning methods in this country; almost simultaneously it was introduced in England by the Wood Norton Powder Company.

The amyl-acetone cleaning solution was first mentioned by Laflin and Rand Powder Company, who made the W. A. powder formulated by Dr. W. G. Hudson, used in the Krag in '91–8.

The above should be applied to the rifle with clean Canton flannel patches, one of two-inch diameter will fit a 30-caliber barrel nicely, while one of 3/4-inch diameter is about right for a 22. They should always be used with a steel or vulcanite covered rod, as the above chemicals have a corrosive action on brass and are best pushed through the bore with a simple knob on the end of the rod relieved a short way back; the pattern advocated by Lieutenant-Colonel Whelen is good but should be threaded in the point to take a bristle or wire brush, which will be found useful for removing unburned grains of powder before applying the ammonia solution, etc.

A brief description of the method of cleaning the Springfield rifle may be used to illustrate the way to employ the various chemical mixtures mentioned.

As soon after firing as possible the bolt should be removed and a bristle brush pushed through the bore from the breech to remove the unburned grains of powder. This should be followed by a dry patch to remove the topmost layer of powder fouling and expose the copper of the jacket metal in the bore.

When the weapon is *cool* and not until then, the breech of the barrel should be plugged with a rubber cork No. 00 and a piece of 3/8-inch rubber tubing about two inches long should be slipped over the muzzle; the bore should then be filled with the ammonia solution, care being taken to see that the liquid comes up above the barrel end in the tube and that none is allowed to spill over the exterior of the barrel, as it will cause rust. The ammonia should be left in the bore for 15 to 20 minutes, not more, when it should be emptied out and the muzzle wiped free from the solution; the cork in the breech can then be removed by a steel cleaning rod, care being taken not to scratch the end of the bore at muzzle. A

dry patch should then be pushed through the barrel from the breech, followed by one wet in soda water or soap and water, and the bore thoroughly dried. Then a patch wet with Hoppe cleaning solution should be run through followed by several clean patches, until the patches show no trace of black or dirt, when the bore may be well coated with Corol or some heavy oil, and safely left.

FIGURE 41. NEIDNER CLEANER

The bolt should be wiped with an oily rag and the outside of the barrel and stock slightly greased, care being taken to be sure and wipe with oil all metal parts that have been in contact with the hands, as the salt from perspiration will quickly cause rust. These cleaning operations are greatly facilitated by the use of a supplemental chamber which is a hollow tube, the diameter of the bore placed in the breech of the rifle in place of the bolt, allowing the patches to be readily centered by the cleaning rod. This device is made by Neidner, Malden, Mass.

The ammonia container is as follows; it will

aid the introduction of the liquid to the bore and prevent its spilling over the outside:

When the rifle is to be cleaned it is stood or held in erect position muzzle upward; the stopper, 19, is removed from the tubing, 16, and inserted into the breech of the gun. The then open lower end of the tubing is slipped over the muzzle of the rifle with a liquid tight fit, whereby none of the liquid ever comes in contact with the outer surface of the barrel. The clamp is then loosened and with the removal of the stopper, 15, the liquid, C, flows freely into and fills the bore of the rifle, leaving, however, preferably a portion of the liquid in the container, which is visible to the operator if the walls thereof are transparent. The chemical reaction that takes place, as a result of the cleansing medium acting upon the metallic deposition within the bore, gives a blue or other distinctive color to the liquid, and, by virtue of the diffusion, imparts a similar color to that portion of the liquid exposed above the tubing. When, according to the experience of the gunner, the color of the liquid is found to be such as to indicate that the cleansing action is completed, he inverts the rifle, removes the stopper, 19, from the breech, and allows the liquid to flow back again into and fill the container. The clamp may then be again closed to

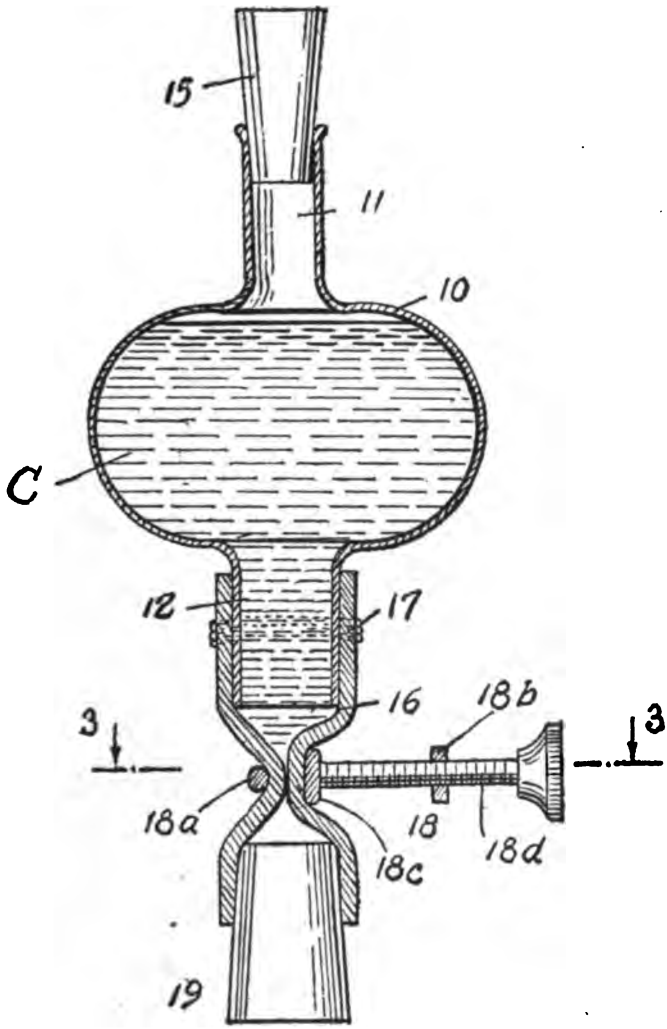


FIGURE 42. AMMONIA CLEANING DEVICE

retain the liquid in the container as before and the stopper, 19, replaced in the tubing as shown in Fig. 42. The gun barrel is then ready to be cleaned mechanically as will be well understood.

The ammonia solution is of a pale canary color and is turned green by the absorption of the copper, and can only be used once. A good oil or preservative for stocks and woodwork is Max Wax made by Eley Bros., London, and obtainable at most gun shops; or a mixture of linseed oil, turpentine and beeswax may be applied to the woodwork of the gun which will help to waterproof and preserve it. Rifles using cordite, a nitro-glycerine powder, should be swabbed after cleaning with ammonia, with a solution of alcohol and caustic soda, which destroys the acid residue in powder fouling.

In cleaning double rifles and those which cannot be filled to the muzzle with ammonia solution, a swabbing preparation may be used. This is composed of the following chemicals:

Ammonia persulphate	50 grains
Ammonia carbonate	25 grains
Ammonia bichromate	5 grains
Stronger ammonia 26%	1 ounce
Glycerine	1 ounce

It should be applied on a flannel patch and should be repeated several times, and in place of using Corol or heavy oil as a rust preventive, Hoppe may be employed, leaving the bore thoroughly soaked with it. On cleaning out the bore after a few days the patches will be seen to be green as the preparation acts on copper but slowly. Guns and rifles are kept safest when not in use with the hammers down and in their cases, and locked with the keys in the owner's possession. This will prevent broken firing pins from snapping locks, bent front sights, and rusted spots from finger marks on the barrels and action.

Locks are best left alone, but if the gun has been wet they should be removed and cleaned with a brush and kerosene oil; an old tooth brush answers well; then they should be dipped in gasoline and wiped dry and the sear tails, triggers, tumblers, and working parts should be oiled with either refined neatsfoot oil thinned with gasoline, or with watchmakers' refined porpoise oil. Care should be taken not to apply too much.

Lock mechanisms, especially in double rifles and guns, should be gone over by the maker at least once each season, and the trigger pulls regulated, etc. The interior of the stock in the lock

wells may be lightly coated with Max Wax or linseed oil and turpentine.

Twenty-two-caliber rifles are best cleaned by pushing one or two dry patches through the bore from the breech followed by a thorough scrubbing with Hoppe or a bristle brush, then more patches should be pushed through until they come out clean,—after which the interior of the bore should be well filled with some mercurial preparation, such as Lead Off or mercurial ointment which of course should be wiped off before shooting; or if the gun is not to be used for some time the cleaning process should be repeated in three or four days.

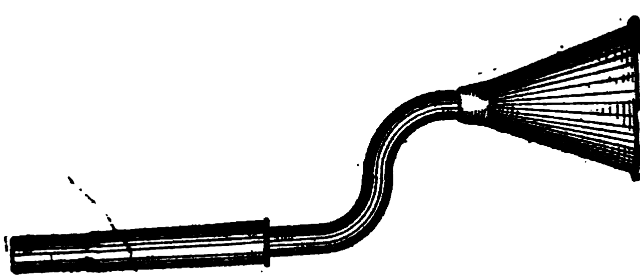


FIGURE 43. HOT-WATER FUNNEL

A very good device which is often seen in English rifle cases consists of an empty cartridge case with the head bored out and a funnel attached, by means of which boiling water may be poured

through the barrel of the rifle (see Fig. 43). It is so simple and the use of hot water so efficient in the stopping and preventing of rust that it should be in the kit of every rifle man. The off-set in the tube enables the cartridge to be inserted easily in bolt action guns and facilitates the pouring of the hot water without spilling.

Another dodge, which is a great labor saver and which is so simple that it is well worth notice, is to soak a number of patches in hot sal soda and water and some more in hot soap suds, strong solution, and to dry them; enough soap or soda will remain in the Canton flannel so that by merely wetting the patch a good alkali solution can be introduced in the bore without trouble, thus saving the carrying of more chemicals or apparatus to the range or on a hunting trip.

CHAPTER VIII

BULLETS

We must realize that each bullet is adapted for each particular rifle and take into consideration the amount of velocity necessary to be borne, the striking energy of the bullet, and the resistance of the object hit.

Primarily, the first attribute of a bullet is accuracy; the second, is to act as a vehicle of energy and to carry the maximum amount of shock delivered by the weapon to the vital organs of the animal shot at. We, therefore, must have a bullet of sufficient diameter and length to accommodate itself to the twist of the rifle, as well as of hard enough construction to withstand the force exerted by the spirals, without stripping across the lands. It must still be soft enough to allow the lands to engrave easily upon its surface and the base to expand to the diameter of the grooves of the rifling, in order not to allow any gas to escape between the exterior surface of the bullet and the walls of the rifle barrel.

The general twist used in 22-caliber rifles is one turn in 25 inches for the short cartridge and one turn in 16 for the long-rifle; depth of the grooves are about three-one-thousandths of an inch, while the number of grooves varies from four to eight. The tendency is to make the lands too wide and too few; most commercial 22s have four grooves and four lands for easy manufacture, but I find that six or eight grooves will give much better accuracy, especially if the weapon is not bored too small, so that the forward portion of the bullet may ride on the lands while the expanded base fills the grooves and acts as gas check. The temper of the bullet or the proportion of lead to tin, upon which depends its hardness and ductility, is generally about one part tin to thirty parts of lead. With the 22 we may divide the bullets into two classes: Solid for target, and hollow point for game. The weight of the 22-long rifle, hollow point, is 35 grains and the weight of the solid, as at present manufactured, is 40 grains; while the lighter bullet has slightly greater velocity, it is not so accurate as the solid and is, therefore, not so reliable.

A very simple method of improving the expansion and increasing the weight of the hollow-

pointed bullet is to insert in the cavity of the point one or more chilled shot, of the diameter of the hole, which helps to expand the forward portion of the bullet on impact; it increases the weight and carries the center of gravity forward to almost the same point as that of the solid bullet.

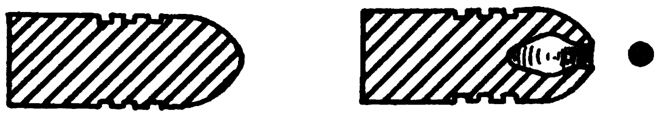


FIGURE 44. 22-CALIBER LONG-RIFLE BULLETS, SOLID AND HOLLOW POINT, MUCH ENLARGED, TO ILLUSTRATE THE INSERTION OF SHOT IN THE CAVITY

With the high-powered rifles of extreme velocity, metal-jacketed bullets are used, which jacket is filled with a lead core. Jackets are generally made of a mixture of copper and nickel known as cupro-nickel, in order to withstand the enormous strain or torque produced by the quick twist of the rifle.

The same principles as to fit and bearing obtain, but since the tough jacket takes a great deal more force to expand it, the bullet has been constructed of groove diameter as it has been found easier to engrave the cut of the lands than to expand the base to the grooved diameter. This, however, has been overcome in a recently

designed bullet, the core of which is of composite construction, similar to the compound bullet used years ago in the long range muzzle loading rifle, and has even been carried further in order to carry the center of gravity nearer the point of the bullet. The construction is as follows (see Figure 11). The forward part of the core is of hard alloy of antimony, tin and lead, the base of softer alloy or pure lead. This core is swaged into the cupro-nickel jacket, and allows, by automatic expansion of the base, the bullet to become a two-cylindered bullet, which seems more accurate than the groove diameter bullet.

In the 30-caliber we have many various weights of bullets and therefore can select the one which will deliver the energy of the blow required to the animal. The standard service bullet weighs 150 grains, with solid jacket, but it has been found that the 180-grain bullet, with an increased powder charge to give it the same velocity as the lighter 150-grain is very much better for long range work. This 180-grain bullet when loaded *friction tight* in the neck of the shell, *without crimp,* has given very satisfactory results as to accuracy, but inasmuch as we cannot use the solid pointed bullet for game

purposes, we are forced to employ a jacket solid at the base and filled with the lead core from the point, which expands or muchrooms on impact. Then, too, in order to protect the sharp point in its flight, it has been necessary to place a cap over the lead core, allowing the rupture between it and the base jacket to occur at this junction of the cap and jacket. Nearly all the expanding bullets have been found too weak at this point to hold their shape in flight and their accuracy is questionable; we are also apt to find that they expand or mushroom too quickly when striking the object and are not a sufficiently stable vehicle to carry the shock deep enough.

Then, too, most of these soft point bullets have a cannellure or groove in the jacket to hold the core firmly in the shell, which weakens the wall of the jacket. The best bullets for accuracy are those of the Newton type, with paper insulation, a pure copper jacket, and a lead core stiffened to the point by a steel wire run through its axis. The amount of expansion may be regulated by the lead exposed, which is a thing impossible to do with the capped bullet.

As at present manufactured, this bullet shows too much lead on the point and breaks up before

sufficient penetration is obtained. Its weight is 172 grains. The Winchester expanding point bullet is made with a cap swaged inside the

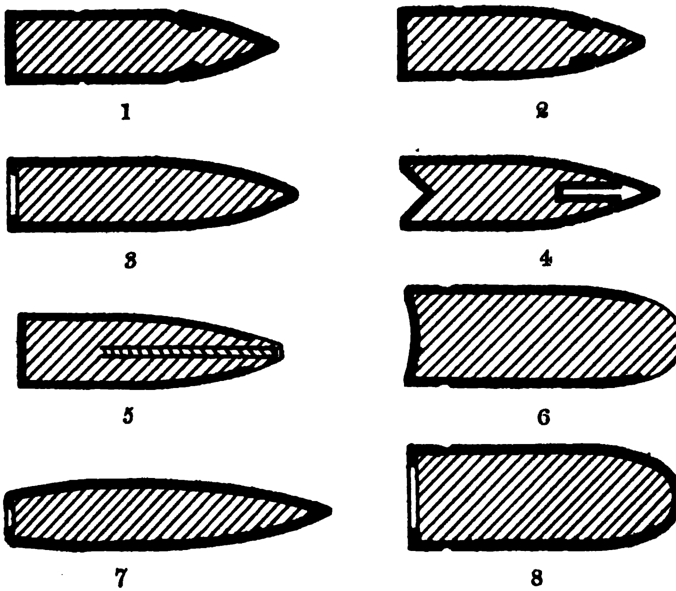


FIGURE 45. SECTIONS OF BULLETS

1, 30-caliber umbrella, 180 grains, expanding; 2, 30-caliber Winchester, 150 grains, soft point; 3, 30-caliber solid jacket, 180 grains; 4, 280 Ross, 143 grains, expanding; 5, 30-caliber Newton, 172 grains, soft point; 6, 465-bore, 480 grains, soft point; 7, 30-caliber boat-tail, 176 grains, solid; 8, 465-bore, 480 grains, solid.

jacket and is only supplied at present in 150-grain weight. It is too light to deliver a sufficient blow and the point extends too far back, thus expanding unduly with small resistance.

This bullet has been recently improved by a reduction of the length of cap and an increase of weight to 180 grains, while the jacket has been made considerably thicker.

Another bullet with a cap or umbrella outside the jacket, although made in both the 150- and 180-grain weights, I have found erratic. It would seem that the cap and body of the bullet in certain cases parted company and traveled in detachments, which, of course, insures not hitting the object aimed at.

It will be readily seen that any advantage that may be obtained from the shape of the bullet, which increases its velocity without impairing its accuracy, is a step in the right direction, especially if no increase in the weight is made, for then we have greater energy with less proportional breech pressure. Many devices have been tried in order to eliminate, or at least decrease, the vacuum formed at its base by the bullet in its flight, which acts as a drag, and the boat-tailed or pointed base bullet has been evolved. The difficulty is to obtain a proper and equal delivery with this curved base from the muzzle of the rifle.

The French Army seems to have solved the problem in a way by tapering the rear portion of

the bullet so that we have a long cone cut off square at the base proper; but they taper it to the point and to the base from the greatest diameter which is the bearing of groove diameter and is too short. We must remember, however, that the range and energy of this bullet, which is swaged cold from a solid bronze alloy, is due in a great measure to its weight, which is 208 grains, while the velocity is below 2,400 feet per second.

Our own Ordnance Department has been experimenting with a bullet having a very long ogive point, a short bearing on its fullest diameter and rather blunt pointed base. This bullet does not seem to have proven very satisfactory and the Du Pont Company have designed one with the forward point consisting of a long ogive, approximately the radius of 11 diameters, and a bearing of about 1/4 inch from the greatest diameter forward, and a base of truncated cone shape. The total length is 4 1/2 diameters. This bullet has been found to give satisfactory results when used with a specially slow burning powder, but, again, the powder on account of its slow and progressive burning qualities has been found difficult to ignite, and a special primer with less intensity and more flash is used. The physical

structure of the bullet is changed and the jacket made nearly three times the thickness of the old service type. The core was also made of a very much harder alloy. This refining of the point has, of course, placed the center of gravity nearer the base while a thickening of the jacket makes it more difficult to disrupt the point on impact.

In order to construct a boat-tailed bullet suitable for use against game it has been found necessary to fill the case from the point and to apply a cap or cone-shaped steel plug to expand the jacket. A well known manufacturing firm has been experimenting with a bullet of this type of about 185 grains weight, and undoubtedly some of these bullets will shortly be available; recent tests are recorded in Appendix VII. As it has not yet been tried on game, however, I would still strongly advise, for the present, use of the older type of 180-grain flat-base bullets. It would, however, be of great interest and value for sportsmen to obtain a few cartridges loaded as above, and try the same on game, the effect of which at present nothing is known.

When we come to the heavy bores of 450 or better, we find that inasmuch as these rifles are used at short range, not over 100 or 150 yards,

and that the one factor demanded is their smashing force, very little account need be taken of their wind-cutting properties, and with the moderate velocity of some 2,200 foot-seconds, we still retain the blunt pointed bullet, using a solid metal jacket filled from the base in order to obtain sufficient penetration on the heavy pachyderm—rhino, elephant, hippo and buffalo. An expanding bullet with the jacket filled from the point with lead exposed is best for the soft-skinned animals. We may regulate the amount of expansion by the amount of lead exposed. Better results will, however, be obtained with a smaller amount of lead point than with the bullets generally supplied. For instance, against African buffalo, one generally uses a soft point in the right barrel and a solid point in the left, while for lion, at close quarters, both barrels should be loaded with soft point.

As regards lead bullets for target use, the sole requirements are accuracy. We may take it as practically decided by those experiments conducted many years ago that a bullet of three and one-half diameters in length, with the forward part of land or bore diameter and the base of groove diameter, will give the best results;

while for use in low-powered rifles, the temper or proportion of tin to lead has been found to range from one in thirty to one in twenty-five. These bullets should be cast true to size and not swaged and for lubrication should have their cannellures filled with a mixture of tallow, beeswax and graphite; as to the lubrication of the metal jacketed bullets, that is touched on in the following chapter. With these lead bullets which are used for target work, a shoulder in front of the forward band will act as a wad cutter or target punch and leave a very clear hole in the target. There seems to be no reason for a greatly refined or wind-cutting point on any bullet designed to be used with not over 1,500 to 1,600 feet velocity.

CHAPTER IX

LUBRICATION OF BULLETS

In the first muzzle loaders the round ball was generally wrapped in a linen or leather patch saturated with either wax or tallow or a mixture of both. These linen patched bullets seat very nicely, the fabric having enough elasticity to fill the grooves of the rifling and when the rifle was fired, the bullet usually of pure lead, expanded sufficiently to act as an almost perfect gas check in conjunction with the greased patch, and the reloading forced the fouling back into the powder chamber, thus leaving the bore practically in the same condition for each shot.

It is rather remarkable to notice the absence of lead and powder fouling in this type of gun and the ease with which the residue of the last shot is cleaned out. It approximates very closely to the Pope barrel loaded from the muzzle and undoubtedly accounts in a great measure for the long shooting life of a weapon thus loaded. With the advent of the breech loader the same

system of patch was followed and with the earlier patterns of Sharp's rifles, and in fact with all the long range match rifles, the paper patch was used. This was usually of a fine grade of bond paper, and was wrapped around the bearing part of the bullet. The ordinary patch consisted of two thicknesses cut on one end to wrap counter to the rifling twist, and the end was cut off and twisted into a spill which was generally turned into the hollow in the bullet-base made for that purpose.

These patches occasionally stuck to the bullet and caused irregularity in flight and there was developed a method of patching of two strips of paper known as the cross patch. These were laid across the bore of the gun, and when the bullet was forced into the barrel, the two pieces being bent formed a covering for the bearing of the bullet. For the breech loaders the paper patch was used of single thickness, designed by Mr. Chase of the Massachusetts Rifle Association, Walnut Hill. Both these two latter systems accomplished what was sought, leaving the bullet or blown away on exit from the barrel. With many of the English rifles there was employed a lubricant in the form of a wad, in addition to the paper patch. This wad was generally

made of tallow and Japan wax and was placed next the bullet in the cartridge with a waterproof wad between it and the powder.

The next step was to provide cannellure or grooves around the circumference of the bullet and to fill these with a rather heavy lubricating wax, trusting to the expansion of the bullet to force the lubricant out to the bore of the rifle; this practice is followed now in the case of lead bullets, very little change having been made in the consistency or ingredients of the lubricant in recent years.

There was a lubricant made by E. A. Leopold, of Norristown, Pennsylvania, known as Banana lubricant, and in '90-'93 at Walnut Hill we all used it for our Schuetzen rifles in the following manner: The bullet was lubricated and passed through a sizing die which removed the excess grease. Then it was seated with a bullet seater in the barrel just in front of the chamber. The shell primed was filled with black powder—I think it was either Curtis and Harvey No. 6 or Hazard's Sea Shooting—a very moist burning black powder of great regularity. A thin sheet of the lubricant was pressed on top of the shell which cut its own wad and kept the powder in

place. This was then seated in the chamber of the gun and it was ready to fire.

In those days it was rather amusing to see the match shooters, at long range, load their rifles—generally muzzle loaders or Sharp's breech loaders; the bullets, usually of compound model (the core and forward part of hard lead alloy and the bearing portion of softer lead), were kept literally in cotton wool. The gun was stood up in the rack, the hammer half cocked and the nipple pricked with a needle to ensure that the vent was clear. Then one wet patch was run through the gun, followed by two dry ones and a slightly oiled one. The powder was sometimes brought in glass phials, weighed and labeled with date and the temperature of last recorded weighing; a funnel was inserted in the muzzle and the powder carefully poured into the barrel, the false muzzle was placed on the gun and two strips of paper inserted in slots; if the cross patch was used the bullet entered in the bullet seater and was driven home with one blow in order not to upset it more than could be avoided; the loading rod was then run through the false muzzle and the bullet seated on the powder. The false muzzle was removed, a cap placed on the nipple

and the piece was ready for firing. This procedure was followed in exact sequence—same number of motions, same number of blows. Even one old shooter used to blow his nose between placing the false muzzle on the rifle and entering the bullet. He was quite angry to know that some of us had bet on his actions. The above incident is quoted merely to show that exact similarity of loading was and still is necessary in rifle shooting.

The standard lubricant for lead bullets is composed of equal parts: Tallow, free from acid; Japan wax and sperm oil or vaseline.

Some use bayberry wax to stiffen, and nearly all add a slight amount of graphite to color and reduce friction.

This lubricant should preferably be applied cold through a grease pump and the surplus lubricant wiped off, care being taken to avoid lubricant on the heel or point of the bullet.

With the advent of smokeless powder and metal jacketed bullets, it was found that the heat developed by friction and powder pressure was so great that a lubricant with a higher melting point was needed.

The Government issued Krag cartridges with

the bullets coated with paraffine, Japan wax and graphite. This, since the bullets were badly made, helped to keep the bullet in the shell and also aided in waterproofing, but was superseded by seating the bullets in shellac, as this made it more waterproof still. It was abandoned and the bullets were made with better jackets, with a cannellure into which the shell mouth was crimped. Still it was undoubtedly necessary to provide some lubricant in order to lessen the wear of the barrel and the subsequent metal fouling.

Among match shooters it was the custom to graphite the interior of a clean barrel before shooting. This proved successful in a way, and the next move was to coat the powder with graphite.

Then the Krag 30/40 was laid on the shelf and the Springfield model 1903, still retaining the 220-grain bullet with round point, but with 2,250 feet per second velocity, was adopted. Here at once the metal fouling increased enormously and it was the custom to use ammonia after each string of 40 shots to remove the metal fouling.

Then came the Spitzer or sharp-pointed bullet in 1906, with 2,700 feet velocity and still more

metal fouling. Graphite was incorporated with the powder in process of manufacture and the chemical constituents were changed to a gun cotton base in place of a nitro-glycerine base with W. A. and Cordite. This change undoubtedly reduced the heat cutting due to the very high temperature of the powder gas, but the fouling from the metal jacket still remained, and with the tendency to increase the velocity became worse. An experiment was tried out with several rifles in the U. S. Marine Corps, using mobilubricant, a heavy mineral grease of high melting and flash point, and it was found that by its use the metal fouling was more evenly spread throughout the bore. With the use of heavier bullets than 150 grains for steadiness in long range shooting and to obtain more shocking power on game, the fouling increased and a mixture of canauba wax was tried on the bullet with some success. I have found that the best method of applying lubricant to the high-power bullet is as follows:

2 ounces Mobilubricant
1 ounce Canauba wax
¼ ounce Beeswax
¼ ounce Japan wax
1 teaspoonful Amorphous Graphite

Melt in a small earthenware dish and mix thoroughly. The bullets seated in the cartridge to be lubricated should be slightly heated and then dipped in the lubricant to the edge of the cartridge case; the points should be wiped clean on a piece of cloth. This will leave the bullets with a band of lubricant in front of the case and the point clean.

In using bullets not lubricated as above, the cartridge should be dipped cold in a small can of mobilubricant *as far* as the mouth of the shell just before firing.

A new method to reduce metal fouling has been used since the War in 1918.

It was observed that with the French 155 Schneider howitzer a strip of soft metal was introduced occasionally into the powder charge; this was found to be a ribbon of nearly pure tin and it undoubtedly did remove the copper left in the bore from the rotating bands of the projectile.

I have seen French artillery officers put the tinfoil wrapping of the primer in the power chamber of the piece evidently with the same purpose in view.

On investigation, the following facts were brought to light:

First, that tin is a most sympathetic and natural alloy of copper.

Second, that the melting point of tin is 446° Fahrenheit, while that of copper is 1,940°.

Third, that a certain amount of tin in either strip or powdered form might be introduced in the powder charge, reducing the pressure materially and slightly lowering the velocity. The tin melting at the low temperature of 446° F. becomes metallic vapor, as the temperature generated by the charge is about 1,500° F. This vapor absorbs and amalgamates with the copper deposit left by the projectile, which is in a partly molten state, and the amalgam passes out at the muzzle, reducing the amount of metal fouling remaining in the barrel some 60 per cent.

Hence, the introduction of a thin wad of pure tin foil over the powder charge, or an amount of tin finely powdered mixed loose with the powder in proportion of three per cent. of the weight of powder charge, will reduce the metallic residue in the barrel with no dangerous results, and may well be applied to all sporting cartridges employing a metal-jacketed bullet of a copper alloy.

CHAPTER X

CARTRIDGES

Too much care and personal attention cannot be given to the careful and accurate loading of cartridges, especially those for use against dangerous game. The shooter's life may depend on a single cartridge and it does not pay to neglect any precaution possible.

As to the powders used for the various guns and bullets, with the selection of three rifles we are limited in choice to those which will give the best results for the purpose in hand. A summary of the characteristics peculiar to each powder suited for the arms will aid in logical choice.

Beginning with the smallest bore, the 22-long rifle, we find the chief difficulty with the cartridge is the proportion of fulminate of mercury in comparison to the propelling charge.

The primer compound is contained in the folded rim of the case and is very corrosive in the action of its residue on the barrel; and unless very carefully mixed—is erratic in its flash.

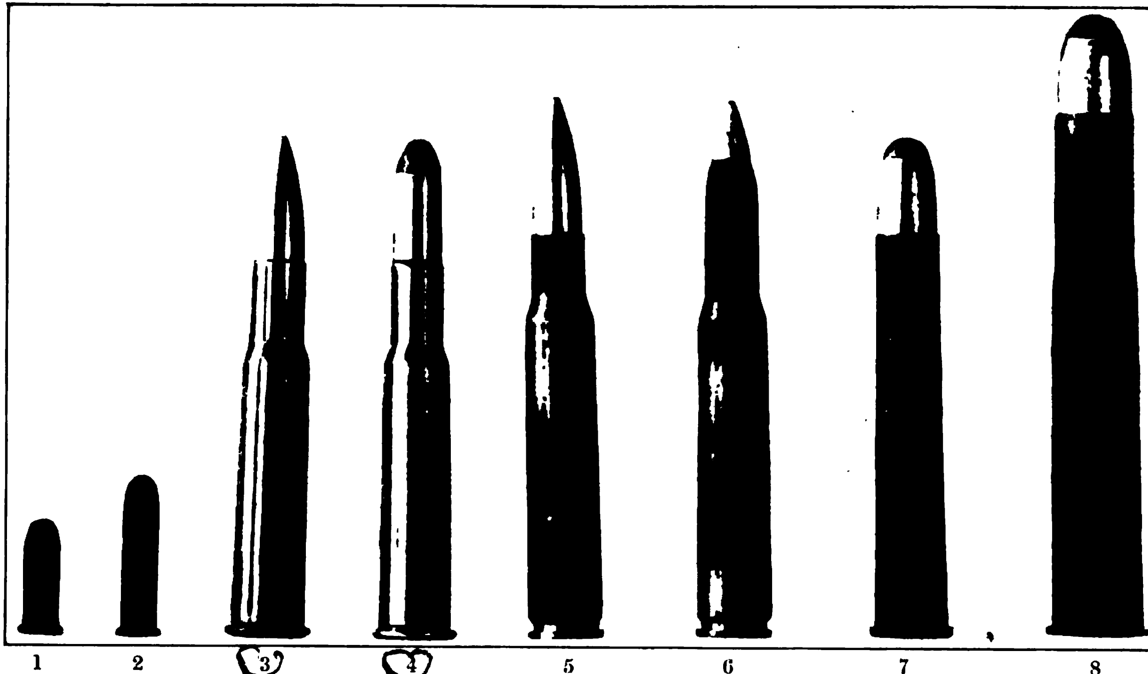


FIGURE 46. COMPARATIVE SIZES OF CARTRIDGES

1, 22 short; 2, 22 long-rifle; 3, Krag 30-caliber, 180-grain Spitzer bullet; 4, Krag 30-caliber, 220-grain soft-point bullet; 5, Springfield '06 30-caliber, 180-grain solid bullet; 6, Springfield '06 30-caliber, 180-grain expanding bullet (with banded lubricant); 7, 375-bore, 300-grain soft-point bullet; 8, 465-bore, 480-grain soft-point bullet.

The powder charge is so small, only 3½ grains, that the priming compound plays an important part in the force exerted on the bullet.

There are three powders in general use in this cartridge, a very fine grain black, a coarser grain of black containing about 20 per cent. of gun cotton and known as Lesmok, and one of the finer grained smokeless bulk powders.

With the first we get rather bad caking which, combined with the grease of the lubrication on the bullet, leaves the barrel, especially in hot weather, with a bad coating of fouling. It has, however, the great advantage of regularity.

The addition of gun cotton, one to five, in the Lesmok aids the ignition, and to a certain degree increases the strength of the powder; the residue is not so tenacious as that of the black. With some of the recent higher velocity cartridges for use at ranges of 100 yards and over, the proportion of gun cotton has been increased, but I think that recently the increase of velocity has been carried too far, and with the stronger cartridges of many makes we find one or two unaccountable shots out of every ten or twenty fired. With smokeless powder generally loaded with unlubricated bullets we get an increase of leading which

alone is sufficient to condemn them, to say nothing of a more corrosive effect of the admixture of fulminate with the residue.

The cartridge which is now in general use is one loaded with 8.4 grains of Lesmok and a taper bullet of 40 grains; velocity of 1,060 feet per second, and in accuracy, while quite exceptional, is hardly as regular as a weaker propelling charge. It is to be hoped that the cartridge companies will shortly give us a 22-long rifle cartridge loaded with 8.5 grains of Lesmok with better percentage of gun-cotton admixture, a velocity of 1,000 feet and a two-diameter bullet of 45 grains with a shoulder back of the ogive to act as a target punch. This will give a muzzle energy of 110 foot-pounds, only some four pounds less than the higher velocity. On account of the heavier bullet, this will be more stable in its ballistic character.

With the 30-caliber high-velocity U. S. Springfield cartridges, our choice is necessarily limited to those powders adapted to the rifle and giving the velocities required with the small powder space in the cartridge case.

Passing over the various powders adapted to guns of different caliber, we will take those espe-

cially designed for the more recent bullets and see what characteristics each has.

All are progressive, that is, burning only fast enough to exert the entire amount of energy and to consume the charge as the bullet reaches the forward part of the bore.

The slowest is No. 15 Du Pont, requiring a greater weight of charge to produce the velocity required than the higher numbers. The best for use with the 180-grain bullet without undue or dangerous pressure and giving the necessary velocity are Nos. 16 and 17, while for the lighter 150-grain bullet we find that No. 20, with slightly more initial pressure, is well adapted. All these powders are manufactured by E. I. du Pont de Nemours and Company, Wilmington, Delaware, and are designed for the purposes stated.

The loading directions for the 150-grain regulation cartridge are as follows:

Shell.—Frankford Arsenal, primer pocket reamed.
Primer.—U. S. A. 49, U.M.C. No. 8 copper or Winchester 35 N.M.
Powder.—49½ grains Du Pont M.R. No. 20 or Pyro.
Bullet.—Winchester 150 grains seated to cannellure in shell and crimped.
Velocity.—2,634 feet per second at 150 feet which equals 2,700 at muzzle.
Pressure.—46,000 pounds per square inch.

With the 180-grain bullet, velocity of 2,700 feet per second, I use the shell and primer recommended for the 150-grain bullet, but employ a charge of Du Pont I.M.R. No. 17 of 48.8 grains weight and obtain a breech pressure of 52,000 to 54,000 pounds.

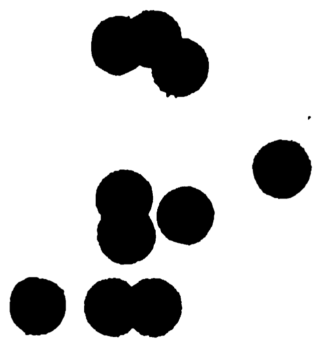


FIGURE 47. TEN SHOTS AT 100 YARDS, MUZZLE AND ELBOW REST, U. S. SPRINGFIELD '03 RIFLE WITH POPE BARREL, LYMAN NO. 48 REAR SIGHT AND SHEARD 1/16 INCH GOLD BEAD FRONT SIGHT, 48.7 GRAINS DU PONT NO. 17 POWDER, 180-GRAIN SOLID-JACKET BULLET, U. M. C. NO. 8 PRIMER. ACTUAL SIZE

Muzzle velocity, 2,710 foot-seconds; muzzle energy, 2,900 foot-pounds. This group was in the 10 ring of six-inch standard American target and measures 1.6 inches in diameter.

Substituting the 172-grain Newton soft point bullet for the 180-grain solid, we get a falling off in velocity of nearly 100 feet per second, and a reduction of breech pressure of some 4,000 pounds; thus we find it logical to increase the

charge of powder to 49½ grains of No. 17 and obtain a pressure of about 50,000 to 52,000 pounds with velocity not quite approximately 2,700 feet.

The jacket of this bullet seems too soft and the point is fuller than that of the solid 180-grain which accounts for lower velocity and pressures. Du Pont I.M.R. No. 15 may be used but it occupies a greater space in the restricted powder chamber and to obtain velocities equal to our requirements we must employ a charge of 53 grains with the 180-grain bullet. The variations of pressure are slightly more erratic due to the reduced air space and run from 52,000 to 55,000 pounds.

A new powder by Du Pont, not yet on the market, has given most remarkable results. Tin is incorporated with the grain and a new retardant used to make it even more progressive in its burning qualities; this makes it appear probable that in the near future we will have a boat-tailed sporting bullet of 200 grains weight with 2,700 feet velocity, normal breech pressures, and with it the other great advantage of practically no metal fouling.

With the 180-grain bullet this powder has

shown muzzle velocity of 2,760 feet and a breech pressure of 51,720 pounds.

For a reduced load for short range not over 200 yards, a load of 19 grains of Du Pont No. 75 and a 150-grain metal jacketed bullet, the velocity is 1,675 feet, breech pressure 44,000 pounds.

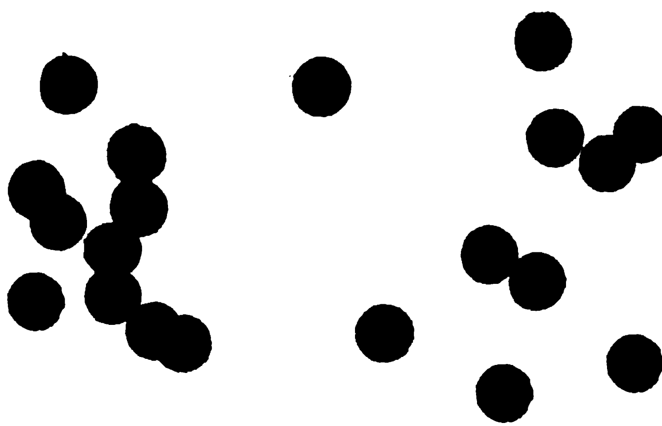


FIGURE 48. GROUPS SHOT WITH U. S. SPRINGFIELD '03 RIFLE WITH REDUCED LOAD OF 19 GRAINS DU PONT NO. 75 POWDER, 150-GRAIN METAL-JACKETED BULLET. LEFT, 50 YARDS; RIGHT, 100 YARDS. ACTUAL SIZE

Tests at New Haven show wonderful regularity of 1,548, 1,548, 1,547, 1,548 feet per second velocity, while at Wilmington several days later on an entirely different set of instruments they ran 1,629, 1,617, 1,623, 1,629 feet per second. The pressure given is the maximum so that the load is wonderfully accurate at short ranges.

Now as we increase the velocity with a given weight of bullet we increase the pressure at the breech but in nothing like the proportion with increased weight of bullet, for here we have more resistance. Likewise, with a grade of powder with slower combustion, we may require a greater amount of resistance by the bullet to develop the latent properties of the powder to the best advantage.

It should be remembered, however, that for sporting purposes, that an energy dependent on no one physical factor is best. For if we get the force of shock by heavy bullet we surely sacrifice some other property of the cartridge. Likewise all the velocity in the world is valueless unless we have a bullet of sufficient cohesion and weight to apply that force and not only to apply it superficially; but we must have such physical properties of the bullet that while expanding sufficiently to insure a proper lateral distribution of the energy it contains it will hold together and will have penetration sufficient to reach the heart and lungs, through hide, muscles, and bones of the shoulder and chest. The disruptive or explosive effect frequently claimed for the Springfield bullet at distances up to 600 yards on soft tissue,

brain, paunch and the intestines of animals, I have never found beyond 60 or 70 yards; and as for depending on velocity alone to transmit, through liquid or semi-liquid contents of stomach or skull, sufficient lateral dispersion of power to explode the container, we cannot count on that in any way at all. With the solid bullets of 180 grains, I have found that the bases were distorted and that the path cut by the bullet on encountering heavy bones was changed in most cases, causing the bullet to tumble or keyhole and cut a slash sideways through the adjacent tissue.

If we increase the weight of the bullet too much we find that we increase the trajectory and therefore increase the chance of vertical error in estimation of range. If we increase the velocity too much we get superficial application of the energy of our bullet and also decrease its accuracy, for we carry the speed beyond the point where the bullet will travel rotating on its longer axis in true flight.

So, too, we must have sufficient twist to keep the bullet point on its flight and not tumble or keyhole in the air on encountering slight resistance.

There are so many elements which go to make

up each of the factors that we can only come to this conclusion: an increase in any one factor, unless counterbalanced by a similar increase in the others, will give uncertain results.

It has been found by experience that the 30-caliber 180-grain bullet with 2,700 feet velocity does give satisfactory results both as to accuracy and energy, but that with the soft point bullets, at present commercially procurable, the tendency is to break up too quickly. This is due, I think, to the general use of these rifles on game not larger than deer and the desire of the cartridge manufacturers to insure expansion of the bullet's point. I know of no really perfectly satisfactory soft-pointed Spitzer bullet yet made—there is something out about each. I have had the best results with Newton bullets; but they are too light, 172 grains, and have too much lead exposed at the point, and so go to pieces too quickly.

One other element in the cartridge and a very important one is the primer. Enough attention has not been paid to the quality of the flash required by different powders to insure the best method of ignition. A sufficient flash with proper intensity to insure ignition at the proper depth in the charge is what is needed.

Some years ago a set of experiments were carried on in England and a very satisfactory solution was found in (shotguns) adapting various primers with different qualities to various smokeless powders. Otherwise the primer was made for the powder. This we have not done in Amer-

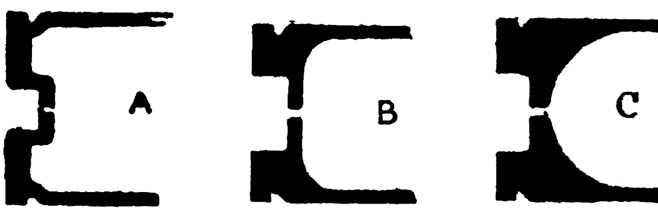


FIGURE 49. SECTION OF INTERIOR OF 30-CALIBER SPRINGFIELD CARTRIDGE CASES

ica and our manufacturers have given us the all around primer for all powders, which is unsatisfactory.

The shape of the interior base of the cartridge case has a great deal to do with the presenting of the powder charge to the primer in proper form and supplying the base from which the energy is applied to the bullet.

With the older type of case, trouble was found with the heads breaking off at the base, especially with the rimless cartridge, which left the base of the cartridge supported by the bolt and not by the chamber. The shape of the interior of

the powder chamber has been changed and more metal left at the weakest point. Figure 49A represents the older case and shows how the walls were too thin at the base. B is the present type of case and C is one made even stronger, which, however, curtails the powder chamber.

It is necessary to be sure that the quality and quantity of the brass at this point of the case be sufficient to prevent any crack or breakage. An incident recently occurred when a well-known cartridge company, either through negligence or because of a saving nature, the brass being very expensive, turned out a lot of weak cases, with the result that on one range there were three burst rifles.

With the very latest pattern of military cartridge, a boat-shaped bullet of improved pattern is employed and the actual construction has been changed in bullet composition both as regards jacket and core. A new powder has been made especially for this bullet which reduces the metal fouling about 60 per cent. The cartridge has given wonderful results, a mean deviation of 2-11/16 inches having been obtained at 600 yards.

A rather laughable state of affairs exists in re-

gard to our Tables of Ranges and Trajectory as compiled by the Ordnance Department, and shows how accurate and reliable the source is.

The range given as maximum with the 150-grain service bullet is 4,400 yards with all the ordinates and remaining velocity, and it has only been found by actual firing this past year that the utmost limit of range reached with the 150-grain bullet was 3,100 yards. The 180-grain bullet carried 4,100 yards and the new 176-grain Swiss pattern reached 5,100 yards, showing how the heavier bullet conserves the remaining energy, and how the change in material and shape have improved the ballistics.

This, with the increased accuracy up to 600 yards at least, absence of metal fouling and low breech pressure, is one of the most important improvements of recent years.

Whether the new bullet will be a good game cartridge remains to be seen. We will undoubtedly obtain accuracy, velocity, low pressure and practically eliminate metal fouling, but I am afraid we will not get satisfactory expansion to insure shocking force.

The above charges have been tried and found thoroughly satisfactory on game and the pres-

sure when the cartridges are loaded properly can be relied on.

As to the necessity of a reduction of charge of powder for use in tropical countries, the Du Pont Company have made a sufficiently stable powder to disregard this element for all practical purposes, and I have found little or no increase of pressure in cartridges that have been to Africa and back. The same may be said for the keeping qualities, for except for the strain at the neck of the shell, caused by seating the bullets friction tight, very little deterioration will be found after even two or three years.

But this cannot be said of Cordite and the powders with nitroglycerine base, for they are affected by heat, the pressures under varying conditions increasing unduly, while with cartridges over eighteen months old a noticeable falling off of accuracy is seen. I have some 375 Cordite cartridges of twelve years vintage, and practically all will keyhole the bullet some eight to twelve inches from the bull at fifty yards.

Now the charges for the big 465 Life Saver have been regulated for tropical conditions and the reduction varies with the different types of powder used. I find that Cordite, when freshly

loaded, and used in temperate climate, gives the best ballistic results, but that for tropical use the flat strip type known as Moddite is superior; there seems to be less deterioration. I have found Axite, another type, to give very erratic results even when freshly loaded and it seems to deteriorate rapidly with age.

If the cartridge manufacturer is consulted and enough insistence made, he will find out the characteristics of the special lot of powder being supplied at the time and will load accordingly. The general load for 465 rifle of 11 to 12 pounds weight, shooting a 480-grain bullet, is 78 to 80 grains of Cordite for temperate zone, 74 to 76 grains for the tropics; Moddite, 76 to 78 temperate; 72 to 74 for tropics.

Messrs. Eley have loaded my cartridges, which I have obtained through Messrs. James Purdey and Sons, London, and I have always found them satisfactory for the heavy rifles.

For the 30-180-2,700, I have had three leading cartridge manufacturers load for me here; Winchester, Union Metallic Cartridge Company, and United States Cartridge Company; I have loaded Frankford Arsenal shells myself.

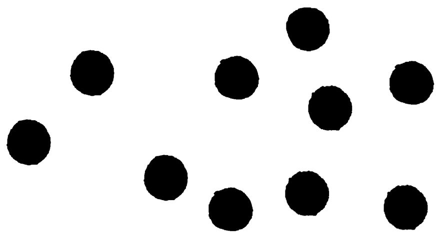


FIGURE 50. TEN SHOTS RIGHT AND LEFT 465 CORDITE RIFLE, FULL CHARGE, SHOT AT 50 YARDS, OFFHAND POSITION. DIAMETER OF GROUP 4⅜ INCHES. REDUCED ONE-HALF

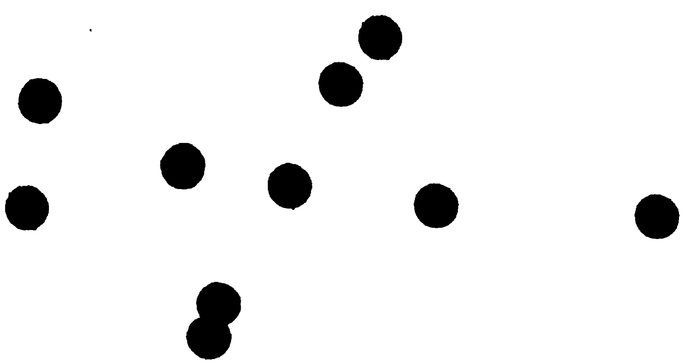


FIGURE 51. TEN SHOTS RIGHT AND LEFT 465 CORDITE RIFLE, FULL CHARGE, SHOT AT 100 YARDS, OFFHAND POSITION. DIAMETER OF GROUP 6⅞ INCHES. REDUCED ONE-HALF

My best results, both as to regularity and accuracy, have been obtained with the U.M.C. No. 8 Primer in a Frankford Government shell, 48.8 grains of Du Pont No. 17 powder, hand weighed, and a Winchester bullet 180 grains, solid metal jacket, seated friction tight. So, at least, my conclusions as to reliability of cartridge material are composite.

With the Krag 30/40, I have found the following loads to give very good results; U.M.C. No. 8 Primer and Frankford Arsenal shell being used in each instance:

Du Pont No. 17, 35 grains; bullet, 220 grains; velocity, 1,980; breech pressure, 36,000 pounds.

Du Pont No. 17, 41 grains; bullet, 180 grains; velocity, 2,360; breech pressure, 41,000 pounds.

Du Pont No. 17, 42 grains; bullet, 172 grains; velocity, 2,400; breech pressure, 40,000 pounds.

All bullets should be band lubricated as described in the chapter on lubrication of bullets and seated friction tight in the neck of the shell. With the 180- and 172-grain bullets, owing to their lighter weight, there will be a slightly greater air space which does nothing but reduce velocity slightly and relieves breech pressure a little.

If it is desired to shoot a reduced load for short range target or small game, the best load is Frankford Arsenal shell and a U.M.C. No. 8 Primer, or if non-mercuric is used, No. 9, 16 grains of Du Pont 75 powder and a 150-grain metal jacket bullet. The accuracy is exceptional at ranges up to 200 yards; the velocity about 1,600 feet and the breech pressure low enough to be perfectly safe. This cartridge, with a soft point bullet does well for a deer cartridge, and, another point in its favor, it does not leave a different metallic fouling in the bore as does a lead bullet. Of course we do not utilize the extreme capabilities of the gun either as to range or killing power, but it makes a pleasant load to practice with. As to the use of lead bullets in a barrel intended for those with metal jacket, my advice is "Don't." You get lead residue in the grooves and it is almost impossible to remove it entirely. Then, too, it affects the shooting of the rifle erratically when again used with metal-jacket ammunition, but if the shooter must try it, or if the dangers in the use of the metal-covered bullet are too great, he will find that good results may be obtained with the following charges, especially if a twist of

one in twelve or one in fourteen in the barrel be used:

Shell.—Frankford, 30-caliber, model 1898, with crease in neck just in front of powder chamber to keep the bullet from receding into the shell.
Primer.—U.M.C. No. 8 or Peters 2½.
Powder.—14½ grains Du Pont Schuetzen.
Bullet.—Ideal 308241 special, with tallow and wax lubrication, weight 158 grains, cast of one part tin to 15 parts lead, seated to crease in neck of shell with a thin cardboard wad at base of bullet.

With this load we employ the methods used in Schuetzen rifles as the load is similar save that the temper of the bullet is made harder on account of the increased twist and the need of more resistance in the material to prevent stripping.

There is one great advantage in this load, its cheapness, for if a shooter makes his own bullets it will cost him, not counting shells, which can be used many times, or those which have been fired with the full charge and can be reloaded with merely the addition of the crease, about $10.00 per thousand.

Still, it is a bad plan to use both lead and metal patched bullets in the same barrel and the use of a 22- or 32-caliber rifle for this work is greatly to be preferred.

CHAPTER XI

ELEVATION

There is no royal road to sighting a rifle absolutely.

To be sure of the elevations and the necessary raises of the rear sight, the rifle should be shot at the ranges to be used and the exact location of the peep hole of the rear sight or the slide bar noted carefully.

In order to measure this accurately and to determine the point of impact of the bullet on the target, we employ a micrometer or Vernier adjustable scale measuring a certain distance on the rear sight in hundredths of an inch,—or even less if the sight adjuster is regulated in proportion to the right radius to produce a change of one inch in the point at which the bullet strikes the target. The distance we elevate or lower the rear sight to produce this effect of one inch 100 yards away is known as a minute of angle.

The simplest way to comprehend the minute of angle is to take a rifle fitted with a peep rear

and a globe front sight fitted with aperture disk and fix it firmly in a rest or vise. We then take a piece of silk thread knotted to a match at one end and pass it through the rear sight peep hole from the rear,—the knot will prevent its passing entirely through. We then thread the free end through the aperture in the disk of the front sight. If we hold the end of the thread on the target and move the rifle until the thread is pulled tight and straight we have a line representing our line of sight, a straight line drawn from the eye through the apertures of rear and front sight to the objective. It is perfectly evident that a movement of the rear sight will cause this straight line to move either up or down, right or left on the target, the distance which is proportionate to the length of the thread from the front to rear sight compared with the distance of that portion of the thread from the front sight of the objective, since our front sight acts as a pivot or axis for two circles; the radius of one is the distance between the sights and the other the distance from sight to objective or target. So we can calculate that the distance the rear sight is moved up or down multiplied by the number of times the sight radius is contained in the range will be

the distance the point of aim is changed on the target.

Now since we know our objective or range radius and the desired arc we wish it to describe —100 yards radius, arc one inch—we can, knowing the distance between our front and rear sight or sight radius, calculate the amount in thousandths of an inch that is necessary to raise or lower the rear sight. While this amount of arc described by the peep hole of the rear sight varies with the length of the sight radius, it still describes that portion of a circle amounting to one inch at 100 yards and is known as a minute of angle.

Let us take for example a rifle, say a Winchester single shot, with a 32-inch barrel and fitted with a Lyman 103 rear tang sight with Vernier vertical and lateral adjustments. It will give us a sight radius of exactly 36 inches or one yard. This is one one-hundredth part of the distance from the muzzle of the gun to the target 100 yards away, so we will find that our minute of angle for this particular rifle is .01 inch. With the service rifle, the sights placed 22.126 inches apart, we find the minute of angle is .0061 of an inch actual movement of rear sight to produce

one inch change on the target, while if we use the Lyman 48 rear sight set back on the receiver, we have a sight radius of 28 inches and our minute of angle will measure .0077 inch. Or, if we use a Lyman 103 sight mounted on the bolt head we add $8\frac{1}{2}$ inches to our sight distance and get with the figure 31.5 inches for our radius and an absolute rise of .0086 inch, but have a more unstable base.

Now our Lyman No. 48 rear sight is graduated in .008 inch for each point or minute of rise and will therefore give us practically our minute of angle of one inch at 100 yards. All the tables which follow are figured on the basis of a minute of angle, as are the wind allowances and those for temperature and barometer. The Lyman 103 sight is graduated in one-half minutes of angle so that it requires twice the movement to obtain the results above. The sights for English double Cordite rifles have folding leaves which are filed to the correct height by the gun maker and stamped with the distance in 100 yards for which the sight is intended.

Now the normal sighting is affected reversely by the height of the front sight; if it is higher, the line of sight remaining straight, the bore will

be depressed at the muzzle and we will require just so much more elevation of our rear sight to correct to normal.

When we raise the rear sight, the line of sight remaining perfectly straight causes the breech end of the barrel to be depressed and points the muzzle higher, thus giving us a greater angle of the axis of the bore prolonged with the line of sight. This angle is known as the angle of departure. If the axis of the bore were prolonged, it would carry the bullet into space but we have gravity which, acting on the bullet, attracts it to the earth and so the flight is a curve upwards and downwards, but always down to the earth finally. This curve is known as the trajectory. Likewise we have the force of any wind there may be blowing the bullet away from its straight flight in the direction in which the wind is blowing, and this curve, added to that of the trajectory, must be allowed for by lateral movement of the sights to compensate for it.

Thus it will be seen that the correct placing of the shot on the objective is directly due to the skill of the shooter in adjusting his sights to allow for this compound curve.

There follows a table of normal elevations for

the U. S. Rifle, Model '03, with '06 ammunition, calculated in minutes of angle, 150-grain bullet with 2,700 foot-seconds velocity, with both U. S. regulation front sight and gold-bead Sheard front sight, with table of elevation for the same rifle, with 180-grain bullet and 2,720 foot-seconds velocity; also table of ballistic data for the 150-grain bullet.

Actual Sighting Used on 30 Springfield, with Lyman 48 Rear Sight, U. S. Regulation Front Sight and Sheard Gold Bead of Diameter .0647 inch, Height .02 inch More Than U. S.

Range, yards	150-grain Bullet, V, 2,700				180-grain Bullet, V, 2,720	
	U. S. Front		Sheard or King		Sheard or King	
	Elevation in Minutes	Come up	Elevation in Minutes	Come up	Elevation in Minutes	Come up
100	2		5		6	
200	5	3	7	2	8	2
300	8	3	11	3	12	4
500	16	8	18	7	18	6
600	20	4	22	4	21	3
800	32	12	34	12	32	11
1,000	48	16	50	16	47	15

It will be seen that the heavier 180-grain bullet needs slightly more elevation up to about 400 yards when the remaining energy begins to tell and at 1,000 yards is a decided advantage.

Since we will hardly have time to change and

Ballistic Data on 150-grain Bullet, U. S. '06 Magazine Rifle, 2,700 foot-seconds Muzzle Velocity, from U. S. Ordnance Table.

Range, yards	Angle of Departure, minutes	Ordinate		Time of Flight, seconds	Remaining Velocity, foot-seconds	Remaining Energy foot-pounds
		Inches	Yards from Muzzle			
100	2.42	.655	50.9	.116	2,465	2,034
200	5.15	2.90	103.8	.243	2,244	1,687
300	8.27	7.15	157.5	.384	2,039	1,392
500	15.92	24.37	270.5	.709	1,668	932
600	20.65	39.24	329.47	.899	1,509	762
800	32.44	87.84	452.23	1,340	1,238	513
1,000	48.20	183.36	580.7	1,864	1,068	382

regulate the rear sight when shooting at game, except for very deliberate shots, we must find an average elevation which may be used for all sporting distances where quick shots may be necessary and make such allowances as we can by holding higher or lower on the animal. It is a very bad practice to change the amount of front sight taken to vary the point of impact; far better to know where your rifle should hit and to vary the point of aim to reach a vital spot.

This is not so formidable a question as it seems, for we will find that the rise and fall of the 30-caliber bullet is only about 7½ inches at 300 yards, so that if we correct for 200 yards some three inches we will have a drop of only 4½ inches at 300 or a continuous danger zone of 10 inches from zero to 300 yards; but as none of our

shots are likely to be under 75 to 100 yards and rarely, unless on the open plains, over 250 yards, we may reduce the striking zone by one-third for general shooting and obtain a vertical deviation of about seven inches for our 30 Springfield at sporting ranges, if we set our sight at 200 yards.

There is another element which, although slight at sporting ranges, must be reckoned with and that is the drift of the bullet caused by the twist of the rifling. And we find that with the right-hand spiral of the Springfield the drift is to the right but is over-corrected by the sight so that it starts to the left, gradually lessening in effect up to about 500 yards, when it crosses the vertical line of fire and becomes zero, and from that point is to the right.

The maximum horizontal deviation is to the left at 300 yards, about one-half inch, while at 1,000 yards it is 18 inches right. This drift is automatically corrected in part by cutting the slide frame of the regulation rear sight at an angle with the true vertical, the intersection of the lines being at 500 yards, and I know of no easier way than to set the regulation rear sight on the rifle at 500 yards, to raise the Lyman sight until the front sight is plainly visible through the peep and

T... ELEVATIONS FOR THE KRAG 1898, WITH 220-GRAIN, BLUFF-... BULLET WITH 2,000 FOOT-SECONDS MUZZLE VELOCITY AND ... FOOT-POUNDS ENERGY AT MUZZLE; THE DRIFT IS TO THE ... UP TO 1,000 YARDS; AFTERWARDS TO THE RIGHT.

Range, yards	Angle of Departure, minutes	Elevation, minutes	Velocity, foot-seconds	Rear Energy, foot-pounds	Time of Flight, seconds
100	4.29	4	1,783	1,553.2	.159
200	9.43	9	1,527	1,235.3	.337
300	15.51	16	1,361	985.2	.537
500	31.35	25	1,100	632.8	1.012
600	41.27	34	1,018	532.6	1.288
800	65.47	56	905	416.3	1.901
1,000	96.01	82	816	337.4	2.587

TABLE OF ELEVATIONS FOR THE KRAG 30/40 1898, WITH SPITZER 180-GRAIN BULLET, 2,300 FOOT-SECONDS MUZZLE VELOCITY, 2,150 FOOT-POUNDS ENERGY AT MUZZLE.

Range, yards	Elevation, minutes	Come Up, minutes
100	3.3	
200	6.8	3.5
300	10.9	4.1
500	21.2	10.3
600	27.5	6.3
800	42.5	15.0
1,000	60.8	18.3

to correct for windage until the sights are centered. The permanent wind scale of the Lyman sight should be set to zero and screwed tight.

It is also a good plan to engrave on the elevation slide of the Lyman rear sight the minutes of angle required for the various distances when the rifle has been shot and proven with the cartridge used, and I have on my rear slide the figures 6-8-11-18-21-32-47 for the 180-grain bullet and on a spare slide the elevation for the 150-grain bul-

let. Then if you set your minimu[illegible]ds a[illegible]on screw for 100 yards and prove the s[illegible]yar[illegible] you can always, when you change your [illegible]rd [illegible]ge, have the correct elevation by slipping [illegible] spare slide.

For the 22-long rifle cartridge a sight set at 30 yards will keep the shots in a 2¼ inch circle at from zero to 50 yards, while with the 450 Cordite the ordinate of trajectory is only 2¼ inches for 100 yards, and with the sight regulated for that distance we may be sure of a hit in an eight-inch circle up to 150 yards if we can hold well enough.

My own 465 Cordite rifle has a standard rear notch for 50 yards with two extra leaves which turn up for 100 and 150 yards, and I have very rarely used any but the lowest sight.

Front sights should be protected with a stalking muzzle when in the field as they are liable to be hit or bent.

CHAPTER XII

WINDAGE AND ATMOSPHERE

The effect of wind, light and weather on the flight of the bullet is variable and the results vary according to the clearness of the atmosphere. In the main, I have endeavored to deduce some few simple rules which may be readily applied without the tedious calculations generally resorted to, and the following "rule-of-thumb" method suffices for all sporting purposes with the 30-180-2,720 rifle.

I have used the 30-150-2,700 Springfield cartridge as an example, for we have some data and tables to deduce from for this cartridge.

As to the calculation of wind, the simplest way to calculate is to suppose the shooter occupies the center of a clock face, the target or objective being represented by the figure 12. We can then designate the various directions from which the wind is blowing as 9 o'clock or 4 o'clock and know what direction is meant. Now the bullet on leaving the barrel is acted on by three elements, only

one of which is constant; that is gravity. The other two are the force of the wind carrying the bullet in the direction towards which the wind is blowing and the density of the atmosphere retarding or accelerating its flight and thus giving the constant force of gravity more or less time to act on the bullet.

For example, we will take the force of the wind at 10 miles per hour, for from that figure we may easily reckon the subdivisions in decimal fractions.

We find that the deflection of the bullet caused by a 9 o'clock wind of 10 miles per hour is as follows (U. S. Ordnance Table):

200 yards	2.90 inches
300 yards	7.40 inches
400 yards	13.92 inches
500 yards	22.90 inches
600 yards	33.60 inches
700 yards	47.60 inches
800 yards	64.00 inches
1,000 yards	106.80 inches

Now, roughly speaking, we may take the square of the distance up to 1,000 yards in hundreds and arrive at the number of inches of correction, which will be closer than any one can hold at the ranges stated; and we get the following results:

Yards	Inches	Actual Correction, inches	Error, inches
200	2 × 2 = 4	2.90	+ 1.1
300	3 × 3 = 9	7.40	+ 1.6
400	4 × 4 = 16	13.92	+ 2.08
500	5 × 5 = 25	22.20	+ 2.80
600	6 × 6 = 36	33.60	+ 2.40
700	7 × 7 = 49	47.60	+ 1.40
800	8 × 8 = 64	64.00	0
1,000	10 × 10 = 100	106.80	— 6.80

Likewise, by rough estimate, we may take a reduction in allowance as follows: For a wind blowing from 10 o'clock instead of 9, deduct ¼ or 25 per cent. from the amount of deflection, and for an 11 o'clock wind deduct still another ¼ or 50 per cent., remembering, however, that for each change of windage from the lateral we must either add or subtract a certain amount from our elevation according to whether the wind is head on or following about ¼ of one minute of angle for each 10 inches added or subtracted from the result obtained for a 9 o'clock or 3 o'clock wind. Roughly speaking, the allowances for vertical error are rarely used on game, the error in estimation of distance being greater than we can allow for.

So we may safely take the average allowances for a fair breeze at 10 miles per hour and either add or subtract from that amount for variation

in direction and, in the case of the 1905 U. S. Government sight or the 48 Lyman receiver sight, divide by four and obtain the points of wind allowance.

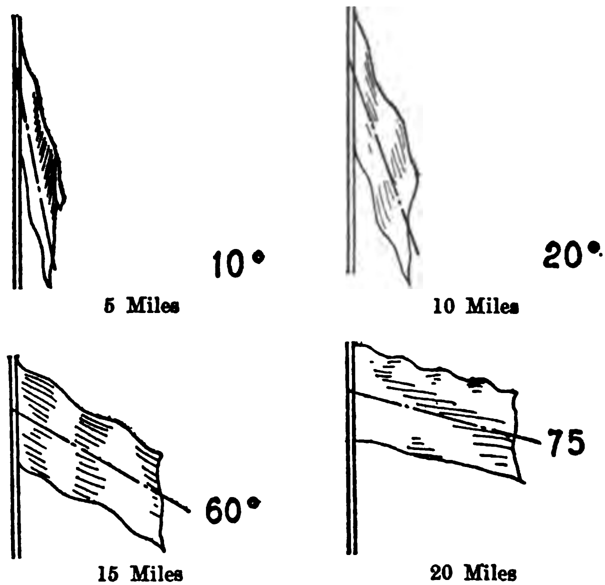


FIGURE 52. WIND FLAGS INDICATING STRENGTH OF WIND IN MILES PER HOUR

Otherwise, a breeze that causes the clouds to move slowly is about 10 miles per hour, and will wave grass lightly or carry smoke below the horizontal. One that moves the clouds perceptibly and causes grass to ripple or smoke to carry to the horizontal is about 15 miles per hour,

while, with a 20-mile wind, we find clouds moving with moderate speed and smoke disappearing shortly after rising, the grass not rippling but steadily laid over at the top.

These are, of course, only rough indications, but may serve to help our judgment as to velocity of wind, but nothing except practice and constant observation will give a man the ability to estimate wind properly.

Then, too, we may judge the drift of very light airs by the heat wave above the ground, known as mirage. This is a condition of the atmosphere when the earth has absorbed a greater amount of heat than is contained for the moment by the air and when there is not sufficient movement or clarity of the atmosphere in immediate contact with the ground in this condition to absorb or carry away the radiation, which may then be observed boiling or gently swaying or moving at an almost imperceptible rate above the earth's surface. A good illustration commonly occurs on looking along a straight stretch of railroad with either sand or rock ballast on a hot day, when this wavering of the atmosphere will be clearly seen to distort the straight line of the metals. This rarely occurs with any wind of 10

miles per hour or better, but with the gentle drift of light breeze is apt to make a very bad mess of shooting at long range, especially over sandy desert or sunbaked range that has become heated. This heat wave makes the objective appear to move upwards and towards the direction of the drift and it is generally a good plan to hold nearer the edge of the objective in the direction from which the heat wave is coming.

In nearly all conditions of mirage there comes a lull or let-up—a hole as it is called—when the objective is clearly seen. If possible, it is best to wait for that and then get the shot away before the mirage flow begins again.

The use of colored lenses minimizes the effect of the visible wave to some extent and I have found the color known as Cook's shade No. 1 the best, as it cuts off the heat rays to some extent as does pale amber of the shade known as Rifleite. A glass of pale Viridia color will also aid but when all is said and done the plan that seems most effective is to wait.

While we may find fault and blaspheme at mirage for our misses, we should not forget that it is one of the most valuable indicators of the air drift when we cannot see any change in other

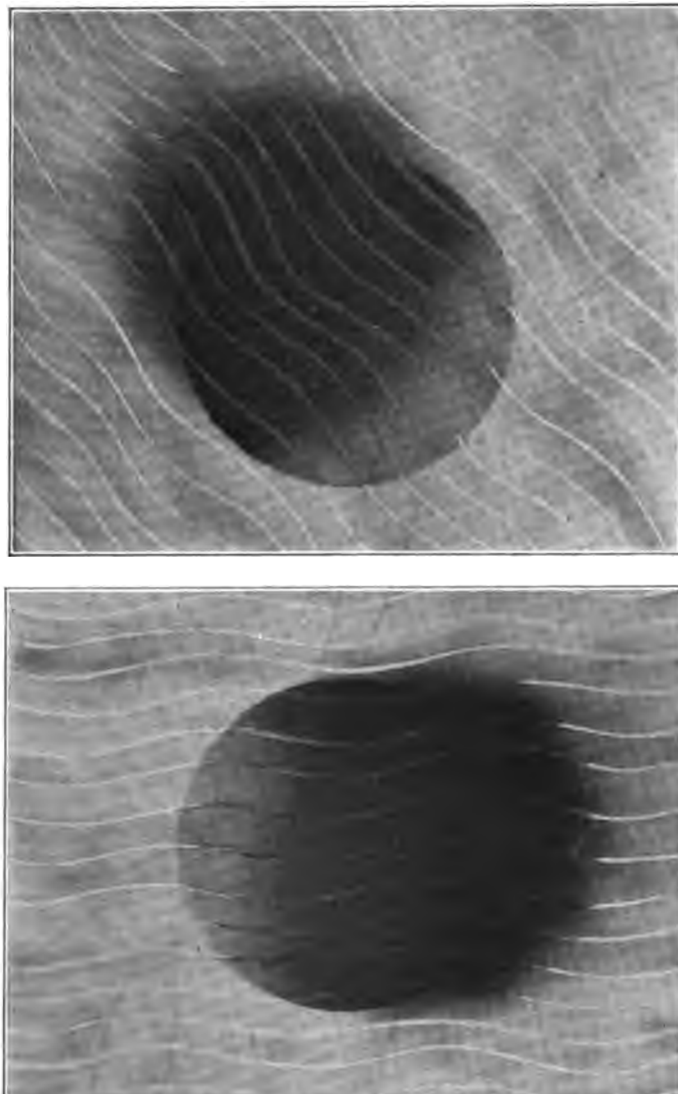


FIGURE 53. MIRAGES AS SEEN THROUGH COACHING TELESCOPE: ABOVE, MIRAGE BOILING UPWARD TO RIGHT; BELOW, MIRAGE FLOWING TO RIGHT

external factors and many a match has been won by a good mirage man at the coaching telescope who can anticipate the change of condition from the indication given and so correct the sights of his team in time to save a bad break in the score. Pale red or pinkish violet will accentuate the heat ray and a shade on telescope eyepiece will magnify the boil made by mirage. While on the subject of light it may be well to touch on colored glasses for general use. No absolute rules can be laid down as to the color most suitable for each man, but I am inclined to think that brown eyes are more affected by the red rays and pale blue or gray by the blue ray. Therefore, it would seem logical to employ a shade of glass to cut the red ray for the brown-eyed man and one to cut the chemical ray for the blue eye.

Thus we should use amber in one of its shades for dark eyes and pale Viridia or Cook's lens for light eyes. The main object of colored lenses, however, is to reduce the glare caused by the blue sky and light colored clouds and so minimize the contrast of color, for it has been found that a level light or monochrome will increase the acuity of vision, and will make the darker ob-

jects stand out more clearly on account of lack of contrast in light value. Of course each shooter should have glasses to correct his sight to normal, especially if astigmatized, and if glasses are used in the tropics it is a good plan to coat them with glycerin and wax or a preparation made in France known as Lasin, which comes in soft pencils and may be applied to both surfaces of the lenses and then wiped off. This is a similar preparation to that used on the eye pieces of gas masks in our Army and will prevent condensation for a considerable period. It is also a good plan to use a bandage across the forehead which prevents the perspiration from running down on the glasses.

The effect of barometric pressure on the bullet is as follows: The lighter the air the less resistance to the bullet and hence a high shot. The reverse is also true of heavy atmosphere, requiring more elevation. This accounts, I think, for a good many misses with a rifle sighted at sea level and shot subsequently in a higher altitude. Then, too, the effect of high altitude on one accustomed to live at sea level is to increase the heart action and for some little time will affect the nervous system. A good general rule is to

correct for each inch of barometric pressure, which is equal to about 900 feet in altitude, one-eighth minute of angle for each 100 yards range; plus or minus taking thirty inches barometric pressure as normal.

With temperature we find that with an increase we get higher shots and a decrease lower. So taking 60° Fahrenheit as normal we can calculate that for each 15° increase or decrease in temperature from 60° Fahrenheit we must either add or subtract $\frac{1}{8}$ of one minute of angle for each 100 yards, or, roughly speaking, one-inch increase or decrease in barometric pressure from 80 inches is equal to $\frac{1}{8}$ of an angle of elevation, while 15° Fahrenheit increase or decrease from 60° Fahrenheit is equal to the same or $\frac{1}{8}$ of one minute of angle for each 100 yards. The method is, I know, not absolutely accurate for scientific purposes, but it will give the changes needed to correct the sighting for altitude and temperature sufficiently to assure good shooting at game.

It is a good plan to correct your sighting for the most commonly used range at the general altitude and temperature at which you expect to shoot.

The question of light resolves itself into a simple problem:

If the range is unknown and the objective stands out clear and bright it will appear nearer than it really is, as in high clear atmosphere, so we underestimate the distance and undershoot; while if the light is dull and gray the objective seems apparently further away and we therefore overshoot. Hence the old saying of "Light up, sights up—light down, sights down." Now this does not hold good when we are shooting at a target at known ranges and holding at 6 o'clock under the bull, for here we have impressed on our mind's eye the color value of the strip of white seen below the bull and with clear definition of the target a smaller amount will give equal color value to almost twice that amount of poorly illuminated surface, and I have therefore found that inasmuch as one holds lower on the target to get the color value on a gray day, just so much will he have to raise his sights to strike in the center of the bull; while, of course, the reverse is true in the case of a clear white target.

I have tried this theory out many times and with targets painted different degrees of gray

drab below the bull and have found that it works out in practice perfectly.

It will be readily seen that with higher altitudes and increased velocity for given ranges we get greater striking force but inasmuch as the external atmospheric pressure is less on the barrel we also get less resistance in the breech.

Whether the amount of strain given the metal is negligible or not I am not sure, but of this I am certain that, in machine guns for airplane work, allowance should be made for these factors both as to sights and breech mechanism.

The saturation of the air with moisture also affects the flight of the bullet, a dry light air giving more friction and a damp condition less, for the dampness seems to act as a lubricant.

This condition should be allowed for by a change of about one minute of angle in elevation increase or decrease as required for each 500 yards, with abnormal conditions. It is negligible, however, below that range.

CHAPTER XIII

JUDGMENT OF DISTANCE

The judgment of distance, and therefore the estimation of range, may be roughly determined by two methods—by eye, the application of a fixed standard and the application thereto of fixed objects, and by ear, or calculation of the time it takes sound to travel a certain distance.

In the field, ranges are determined in practically all cases by the judgment of distance—by eye. It will be found not difficult to apply distances marked and fixed for target practice to the general landscape. Take a minimum distance as 100 yards, that should be fixed very firmly in the mind and should be used, if I may so say, as a yard stick, to be laid down so many times from the position occupied by the shooter to the objective. In preliminary practice, this estimation of distance should be verified by pacing, if possible.

A standard measure of 100 yards is taken because it adapts itself more easily to the average

man, and, also, because rear sights are graduated in 100 yards or multiples thereof; and if graduated by Vernier or micrometer readings, we generally say so many minutes of angle are equal to so many hundred yards.

The visibility of the figure of the objective makes a great difference in the apparent distance. The greater the visibility, the nearer the object seems; as does a vivid contrast between the objective and background. And, so, we may take the old saying of, "Target stands up equals sights up, target down, sights down," as our rule; and we will make but small mistake. Then, too, distance may be calculated by the visibility of a man's features and portions of his dress. A man's features and face are clearly seen at 100 yards, his face but not features at 500 yards. A rifle held away from the body at 700 yards, and the general outline of figure at 1,000 yards. If we apply this to game, we will find that the eye, ear and nostrils are seen at distances under 100 yards, the horns and outline of the head are distinctly visible up to 800, but beyond that we merely get general contour of the animal, unless he is standing against the skyline or presents a marked contrast to the background.

When shooting over a depression or valley, it will be noted that the objective seems farther away. Down hill, the object will appear nearer, and up hill, farther off than it really is. Added to this the tendency to overshoot down hill and to undershoot up hill may also be accounted for by the angle at which the force of gravity acts upon the bullet in relation to its line of flight; if more acute towards the point it will accelerate the speed of the bullet, and if more acute towards the base, will retard. For elevation depends on horizontal distance of objective. We therefore find that down-hill shots are of less distance horizontally than those on a level and will require less elevation. I think that the tendency of down-hill shots is for the shooter not to place his face closely enough to the cheek of the stock, and he will therefore overshoot.

A very easy way of computing distance by the comparison of various objects is within certain limitations accurate enough, but we must first have a standard absolutely defined upon which to base our judgment of comparison. Now, obviously the object most often seen is man himself, and the average height is about 5 feet 8 inches; but we must compare this

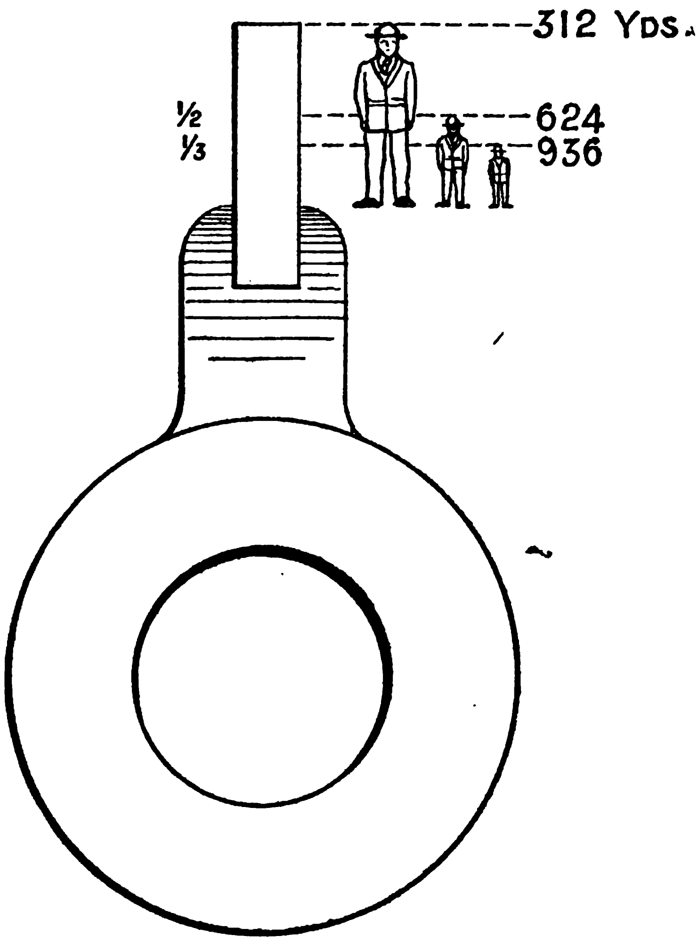


FIGURE 54. JUDGMENT OF DISTANCE BY COMPARISON WITH HEIGHT OF FRONT SIGHT

object with some definite measure in order to know how far away it is. The one standard always at hand to measure by is the front sight of the rifle. Now, this front sight is always at the same distance from the eye when aiming and so if we employ the height of the front sight in the manner of a stadia measure, in comparison

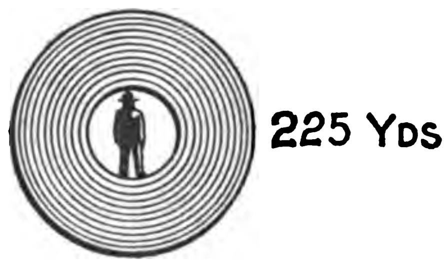


FIGURE 55. JUDGMENT OF DISTANCE BY COMPARISON WITH BORE OF 30-CALIBER RIFLE

with the height of a man, we can arrive at some fairly accurate estimate of the distance the figure is away. For example, the height of a man equals 68 inches, the front sight of a U. S. Springfield Rifle Model 1903 above the movable stud is 15/64ths of an inch. The distance from this front sight to the eye in normal aiming position is 35 inches, and, therefore, we find that on looking through the rear sight, a man's figure will correspond to the height of the front sight

at 312 yards, to one-half the height at 624, and to one-third at 936. By comparison of the height of any game at the shoulder to the height of a man, we can easily estimate the range.

We may also take it for granted that the width of the top of the front sight is equal to the width of a man's face, or 12 inches at 300 yards. This, then, would mean that at 600 yards, the width of the sight is equal to about 24 inches, the width of a man's shoulders.

Another dodge which may be found useful in the estimation of distance is to remove the bolt from the rifle and look through the barrel; since the bore is equal to 3/10ths of an inch, we find that a man will just equal its diameter at 225 yards.

But in the field, it seems safer to rely on the yard-stick method of the distance most easily fixed in mind, and no pains should be spared to train the shooters to the accurate conception of distance on every possible occasion.

CHAPTER XIV

POSITION

Position may be defined as using the body as a support to hold the piece in the most advantageous manner to secure accuracy. Otherwise the body is the gun carriage and mechanism by which the rifle is aimed at the object.

Now an absolute rule cannot be laid down as the conformation of each individual differs, so must the absolute position be modified and the body be adapted to the nearest approach to the position found the most practical and comfortable for the average man. More definite instruction can be given in the standing or off-hand position as to the proper position of the head, for the instructor can then see what faults are committed by the shooter as to canting the piece, the quick jerk of the trigger as opposed to the even smooth pull, the shutting of the eyes, the flinching, etc.

Off-hand position should be, feet planted firmly, not too close together, left foot advanced about 18 inches, ball of foot in same line as heel

FIGURE 56. OFFHAND POSITION OF AMERICAN RIFLEMAN
(AFTER CHAPMAN, 1848)

of the right. Shoulders turned about three-quarters to the right, the weight slightly more on the left foot.

The rifle should be grasped in both hands, left arm about one-half extended, left elbow under the piece, right hand grasping small of stock firmly, right thumb extended forward along the right side of stock, right forefinger engaging the trigger on second joint; right elbow at not more than 90 degrees from body. The heel of the rifle should be pressed well into the hollow between shoulder and chest but held low enough to prevent the butt striking the collar bone on recoil. Left eye should be closed and head carried forward and down to the right until right eye is in line of sight; right cheek pressing the comb of stock firmly, in order that the piece shall be supported mainly by the left hand, shoulder, and cheek.

The reason for placing left foot forward and throwing the weight thereon, is to allow the body to act as recoil check, which is done by the automatic shifting of the weight by recoil of gun to right foot.

Sitting Position.—Face half right and assisted by the left hand and the butt of the rifle sit down

facing slightly to the right. The left leg is directed forward to the target, the right leg, at about 45 degrees to the right, both heels firmly placed on the ground; it is best to dig small holes with the heels to insure firmness; the knees well apart but the right kept somewhat higher than the left.

The left arm is rested on the left knee, the elbow in front of the patella, as in the kneeling position, the right upper arm outside of the back of the elbow point on the inside of the right leg back of the knee.

This position may, of course, be varied to suit the individual, but in the main the above will be found suitable.

Care should be taken to choose the seat, if possible, with the body slightly higher than the heels and to be sure that there are no grass twigs, etc., intervening between the shooter and his objective.

The kneeling position, which is preferable to the sitting for a quick shot, is as follows: Drop on right knee, lower leg to the left, advance left foot about 20 inches in line with right knee, take same arm position as in off-hand save that the left arm outside and back of elbow point rests

on top of left knee just in front of knee-cap or patella.

Prone Position.—Lie down, head to target, both legs swung well to the left, right elbow flattened to right and away from body, left forward and well under barrel of rifle. The butt should be held under the point of the shoulder and upon recoil should slide freely under the arm pit, thus preventing the undue shock and bruising of the shoulder. The gun sling may be employed as an aid to steady holding in two ways: First, pass the left arm through the forward loop of sling, tighten the keeper to keep the loop firmly above the left elbow, grasp stock with left hand strap, passing to right of left wrist, and by either moving the left hand forward or backward the pressure on the sling may be either diminished or increased; second, disregard the loop and adjust the sling for carrying over shoulder in easy position. With the piece held in right hand at small of stock muzzle, forward pass left arm across between sling and stock to right, then pass left hand under sling and to left and grasp the rifle with left hand in front of trigger guard and magazine plate. The sling should pass to the left of the upper arm and to the right of the fore-

arm. This method is the one most quickly and easily employed and is also the position most readily disengaged from.

There is still another method of employing the sling when firing over a parapet or sand bag rest. The sling is detached from the butt swivel, the strap held tightly in the left hand, the rifle rested at or just back of the forward swivel on the sand bag or soft earth parapet. Pressure is then exerted on the strap backwards and downward. This will force the butt of the rifle against the shoulder. If this method of hold is employed it should be remembered that the flip of the rifle against the rest will amount to some 70 yards rise in 600 yards, or practically the sights should be lowered about 10 per cent. of the estimated range.

The above directions, while written from a purely military point, are easily applied in the field when the conformation of the ground permits.

I have found that for sporting purposes, the standing and sitting positions are the ones most generally used; in fact, I have found it impossible to employ the prone position except at long ranges in the mountains for sheep or goat, grass

and underbrush generally interfering with a view of the object.

Unless the game is within moderate sporting range, say under 200 yards, the use of a tree or log will steady the rifle wonderfully, especially after a long climb, but care should be taken to put a cap or glove between the barrel of the rifle and the rest used, or a high shot will result, as with the sand bag rest.

Above all the position should not be cramped nor should the muscles be held under strong tension, as a tremor will occur.

CHAPTER XV

AIMING AND TRIGGER SQUEEZE

To have a constant error of aim, which every one has to a greater or less degree and is known as "personal error" or "personal factor," we should be absolutely sure to see the same amount of front sight in the same position with regard to the rear sight for every shot; unless this is done it is impossible to know whether the fault lies with sights or with the method of application.

The aiming exercise as set down in the *Small Arms Firing Manual,* using the small movable disk for the objective and making a triangle with three shots, will show the shooter what his average error is (see Appendix III). If the greater dimension of the triangle is vertical then we see either too much or too little front sight, while if it be lateral, we are sighting through one side or other of the rear aperture. It makes no difference what error we make in sighting, for if we do it exactly the same each shot, we can then correct the alignment of sights to allow for

our personal error, but it will be readily seen that we must have the personal error made as nearly a constant factor as possible to make any sort of accurate correction mechanically.

Likewise, if we tip the sight either right or left, we will find that it acts exactly the same as moving our elevation and wind on the rear sight. This fault is known as canting the rifle, and a movement of the sight either to the right or left of the vertical will cause the shots to strike lower and to the side to which the sight is canted.

DEVIATION OF POINT OF IMPACT CAUSED BY CANTING THE RIFLE 10°; DRIFT AND FLIP NOT COUNTED

Range, yards	Lateral Error, inches	Vertical Error inches
200	1.4	negligible
300	4.2	.125
500	13.5	.25
600	20.	.75
800	42.	2.50
1,000	70.	6.00

This is one reason for the necessity of the position of the forearm as nearly vertical as possible for support to the rifle, for it will lessen the tendency for the muscles to turn the rifle to make the grip of the left hand more comfortable.

The trigger squeeze or pull should be gradually increased by the right forefinger so that the point of aim will not be disturbed until the shot

is fired; then, of course, we get the vibration imparted to the barrel mechanically by the fall of the hammer which will be found to be almost as great as the movement of the barrel by the explosion of the cartridge which affects the point of aim even more than the latter, for it has been found that the true vibration of the barrel caused by the explosion of the cartridge does not occur until the bullet has left the muzzle of the rifle. What does take place is a gradual bending of the bore in a vertical plane from the breech to the muzzle caused by the support of the barrel, action, stock and shoulder being below the axis of the bore. The regularity of this curve is broken if a solid support be placed between the action and the muzzle, and a double wave of curve is formed which will explain why a rifle will shoot higher from a rest than from the shoulder. The downward curve from the action to the muzzle is interrupted and reversed by the rest, causing a high instead of a low shot.

This curve is also affected laterally by the resistance of the rifling to the bullet.

The recoil acting on a line of the axis of the bore, with the shoulder as a fixed rest below the line of recoil, will tend to pivot the gun on the

shoulder and lift the muzzle, which is the reason we should employ a firm grip with the left hand to prevent this.

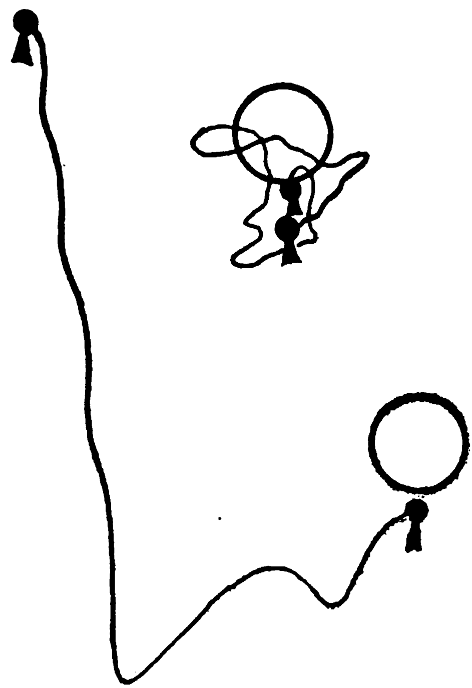


FIGURE 57. TREMOR OF SIGHT (A) AND WAVER OF SIGHTING (B)

In the bringing of the sights into line with the objective we can divide the movement into two distinct phases. The preliminary waver of the front sight while the shooter is trying to find the objective, and the tremor of sight while en-

deavoring to hold the front sight on the mark. Both are necessarily present but may be minimized to a great extent. The first is purely a mental error and is known as "fishing for the bull." Decide where you want to aim on either animal or target and put the front sight on that spot. A good illustration of what I mean occurred in one of our National Rifle Association school-boy shoots in New York. One small chap was talking over the trouble he had in seeing the bull's-eye, when a colored boy chimed in with the remark, "De muzzle of your rifle was sure moving some. I done think you was trying to wind up a clock wid it."

Look at the objective, bring the rifle up into line, look through the rear sight and put the front sight where you want it. Don't hesitate, don't try for a second alignment unless you put the gun down from your shoulder, and go through the process once more; game will not stand still indefinitely.

The second aberration of sight is that which occurs when the front sight had been placed on the mark and the shooter is trying to hold it there while he pulls the trigger. This movement is caused either by muscular involuntary

tremor or by the pulsation of the heart. The muscular waver is generally caused by the infrequent use of the muscles employed in holding the gun; they are not sufficiently trained by exercise to hold the strain of the gun even for the moment of pulling the trigger. The only way to overcome this is to train the muscles until they do become accustomed to the position, and the twitch and tremor cease.

It is a good plan to have a rifle in one's bedroom and a small target affixed to the wall some 15 feet away. Every morning and evening put the rifle up on the mark, hold it there and pull the trigger on an empty cartridge case or dummy. It is surprising how even five minutes spent thus every day will improve your hold.

Then, too, the muscles will become accustomed to the various positions and no difficulty will be found on the range; but it must be done regularly.

The tremor or bump caused by the pulse and imparted to the rifle may be partially avoided by inhaling and holding the breath during the moment of trigger pull. This will make the pulse more regular, not so jumpy.

When using the sling, this heart movement is

most noticeable as the veins of the upper arm impart the throb to the tight sling which is in turn transmitted to the rifle barrel. It may be minimized by the application of a bandage to the left upper arm, put on tightly enough to decrease the blood flow, but it should be removed after firing and the arm well rubbed to restore circulation. This is, of course, impossible to do in the field and I therefore do not advise the use of a very tight sling with loop of military pattern.

The general rule to follow is to have the muscles rigid enough to ensure steady hold, but not sufficiently tense to cause tremor; and not to have the sling so tight that it transmits the pulsation of the heart unduly.

The gradual application of force generally recommended in military target shooting is the outcome of the heavy pull required for the double pull on our military arms;—for a fairly heavy pull of three or four pounds, there seems an excuse; for the take up and secondary pull, none; it only teaches a man to play with the trigger and interferes perceptibly with a quick clean shot. It helps to make a man poke and wait for the shot to go off and should never be seen on a sporting

rifle. A pull of sufficient weight, to insure against the accidental discharge of the piece by jar of a blow on the butt, or a fall, depends more on the shape of the sear-tail than on the weight of pull.

Above all, in shooting at game, don't dwell and poke; it only encourages indecision and clumsy trigger work with the fingers. Put your front sight on the part of the game you wish to hit, and fire; only waiting long enough to insure the proper alignment of sights and pressing the trigger in a manner to give the least possible disturbance to the front sight. The latter is best obtained by a gradual contraction of thumb and forefinger, applying the pressure as if squeezing the last drop of water from a sponge, so that the shot will be discharged without perceptible spasmodic movement of the trigger finger.

CHAPTER XVI

STALKING AND COVER

The getting within most advantageous range for the shot at game is really the whole pleasure and excitement of shooting. It is very unsportsmanlike to take long chances probably wounding some poor brute in order to spare the sportsman who is too lazy or too ignorant to try to get closer. Colonel Roosevelt, Sir F. J. Jackson, Cunninghame, Selous, Akeley, and many other sportsmen with whom I have talked over the matter of range, all agree that the employment of the long range small-bore rifle to save the trouble of stalking is about the surest evidence that such a man has no place in the great outdoors. One of our rifle authorities, so-called, has written of shooting antelope at 1,500 yards and of hitting them regularly. He may have shot at them, thereby stamping himself as unworthy to be called a sportsman, but I doubt if he hit many, for the antelope's measurement through the brisket is only 16 inches on the average, and at a range

FIGURE 58. PART OF THE AUTHOR'S BAG, BRITISH EAST AFRICA, 1910–11

of 1,500 yards the animal would hardly be visible.

It is generally conceded that 300 yards should be about the maximum range for a shot on the plains in the open. If you can't get nearer wait until the game moves and try again. Never shoot at the brown of an animal—always pick the spot you intend to hit with reference to the vital parts and hold for that. It is impossible to shoot with accuracy beyond the range given, for animals do not carry bull's-eyes painted on their sides to indicate the exact location of their hearts. Then, too, one must remember that the nearer one gets for the shot the surer he is of putting the bullet where it will do the most good, and in the case of dangerous game, this is essential and will save many a charge, for one well placed shot is worth any amount of badly aimed ones. It is a good plan to approach and keep on approaching the game as long as it is unaware of your presence. Of course, the approach should be upwind, if possible, or at any rate across wind—never down, for if a herd or single animal starts, it will generally run or charge, if it means business, upwind towards the direction in which the danger lies.

I have seen native trackers pull the feathery

grass heads, and, during a stalk on elephants, toss a few shreds into the air to see which way the wind blows. If the finger is wet and held up, the current of the air will be felt cooler on the side from which it is blowing. Then, too, every advantage should be taken that is possible of cover, scrub, grass, hillocks and trees; the shooter should look over the ground and map out his route of approach and then work from cover to cover. Crawling face down when necessary and remaining absolutely stationary when the animal raises its head, only advancing when it is seen that the head of the quarry is turned in another direction.

It is a good plan when crossing a bare or open space to hold a branch in front of your face or in front of your head if crawling; then if a look has to be taken at the game the head should be lifted slowly behind the branch, the look taken and crawl resumed with the branch held as before.

Sometimes, especially on the first snow on caribou barrens, a white coat and cap will be found of advantage. As regards clothes, the best tip is to take the idea of camouflage from the game itself and to follow the same scheme of protective coloration.

In our shooting here in America in the woods one hears of long shots being taken. I doubt if 10 per cent. of the moose are killed farther than 100 yards, while for deer 60 yards would be a closer estimate. Long shots over water at moose, or across a gulch or cañon at sheep or goat, may sometimes be permitted if no nearer approach can be made, but one should study the habits of the game and the general character of the ground thoroughly before starting on a trip. If this is done it will save a lot of misses and a lot of needless suffering of wounded game. Energy and velocity are not to help the lazy man with long shots, but to give the smashing blow needed to kill and to do it neatly. Above all do not shoot merely to kill, but have some object in view: meat for camp or a really good head.

A telescope is of little value, being too clumsy and hard to use. I have never seen any one handle one properly save a few deer stalkers on a Scotch hill, and that is generally a leisurely proceeding. Binoculars are far better. Those of eight power are about right to pick out good heads with and will save a lot of shoe leather and cuss words, for I know of nothing more exasperating than to find out that the head you have

been stalking for an hour or more is not worth shooting.

In using glasses to locate game, it is best to look for some object slightly differing in outline from the surroundings. Game is hard to pick out in the bush and the general contour of an animal is more readily discernible than the difference in color. I remember a case with a big bull giraffe near the Isiolo River in Africa. I had seen him at a distance to be much larger than the rest of the herd and had vainly endeavored to stalk him for two days. He was so big I determined to have him, and on the morning of the third day found him in a clump of table-topped mimosa trees. The stalk began and for over an hour in the sun at 10 A. M., temperature near 110°, I crawled, wriggled and struggled to a bunch of grass about 80 yards away from where I had seen the bull. I raised my head and to my astonishment he had disappeared. "He's gone," I said to my Somali gun-bearer. "Hapana, twiga hapa, Bwana" ("No, the giraffe is there"), whispered he, and passed me my glasses. Sure enough there he was back a few yards in the edge of the trees. I looked to my rifle, the 465 Cordite, intending to take a sitting shot and

FIGURE 59. ROTHSCHILD'S GIRAFFE (RETICULATA), SHOT ON ISIOLO RIVER, BRITISH EAST AFRICA, 1911; HEIGHT, 19 FEET, 3 INCHES

be sure of his shoulder. When I looked up I could not see him. Finally, after two further attempts I decided to stand up and shoot as he moved. This I did, and he lurched forward and stood in the open, the first shot being well placed back of his shoulders.

We ran up to him and I gave him another while he staggered there. Suddenly the gun-bearer pulled my arm. "Look out Bwana he falls," and sure enough he crashed down, his head within 10 feet of me. He was of the species *Reticulata Rothschilds*, the netted giraffe; he was a dark chestnut with white net-work markings and measured 19 feet, 8 inches, a world's record. While he stood in the light and shadow with the sun shining through the branches on him, I could not for the life of me make out where to shoot, he blended so perfectly with the surroundings.

I mention this to show how even a big animal at close quarters can be effectively camouflaged by color.

Two methods, recognized as warrantable, that of floating in canoe and of calling in the rutting season, are employed in shooting moose. Neither requires special skill, except as to marksmanship, unless the shooter sculls his own canoe

or does his own calling, both offices being generally relegated to a guide.

In floating, the canoe is gently sculled along a dead water or around the various points and coves of a lake and when a moose is seen, either in the water or on the bank, the guide sculls the canoe up to within shooting distance and the trick is done.

With calling it is different, for the moose is enticed by an imitation of a cow moose's call when bulling and answers from some distance generally; the call of the cow is repeated by the guide and the bull answers again. It is not difficult to get a bull to come, but the real art is to make him show in the open; then the caller is put to every device known to deceive the animal, giving low plaintive and pleading grunts, rubbing the birch bark horn, through which he calls against the bushes in imitation of another bull thrashing his horns, pouring water through the horn on the ground or in the lake in imitation of a cow urinating, in fact practicing all the arts of cajolery and seduction he can imagine, to bring the bull into view. As a rule, the bull will come to the edge of the timber or thicket, and will then try to circle and get the shooter's wind, and

if he once surmises something wrong, will move off quickly. Sometimes it is a good plan to have the guide retire quietly in the opposite direction to which the bull is approaching and to call softly at short intervals; the bull will then come out to follow the cow who he thinks is receding and give a clear shot. In Maine the guides used to call in the night, choosing calm moonlight ones, but in Canada they generally call in early morning or late in the afternoon for the moose prefers to do his love-making at night and you are more apt to catch him en route at these times.

The edge of an open bog or point in a stream or deadwater is generally chosen as the place for calling and a rough blind is hastily constructed. The shooter then proceeds to call and listen for an answer. Sometimes he draws blank and again may have two or even three bulls coming at once. The rut generally begins on the moon after the middle of September and lasts about a fortnight or three weeks. The essentials of success are calm clear weather with sharp frosty nights.

A description of calling a moose may not be out of place. In October, 1908, the 12th, I believe, ideal weather conditions prevailed on my preserve on the upper Patapedia River, Quebec,

Canada. The night had been cold and the leaves and bushes were covered with white frost. Leaving camp before sunrise, I walked with my guide, Harvey Miles, whom I employed for over 10 years each fall for the moose hunting, about two miles to a bend in the river between two lakes known as the Slide, where there had been some old landings from previous lumbering operations. The leaves on birch and maple were full of autumn tints of yellow, gold, orange and vivid carmine; the air was perfectly still and carried sound a long distance.

We commenced calling at about 6:30 and almost immediately got an answer from a hill on the other side of the river at least two miles away. Waiting about 10 minutes, Harvey called again and again and received the answer—this time nearer. Again waiting, we heard the bull grunt on the other bank of the river back in the woods and shortly afterwards he crossed, still out of sight, but making a great deal of noise breaking the drift wood and dry stubs on the bank. The hillside on which I was waiting was covered with light second growth of birch and poplar with a few Prince's pines about twelve to fifteen feet high, and one could see through them some 80

to 100 yards, and a bit farther, up the trail which ran along the crest of the hill parallel to the river.

Suddenly all noise from the bull stopped and I thought he had turned back, but evidently he was only standing, listening and watching. Presently the faint snapping of twigs began again as he breasted the rise to the trail and he came into view. "God, he's a big one," whispered Harvey, "plug him now." But I waited until he came to the trail. He was evidently circling to try and get our wind, and as he advanced through the birches, he tilted his head to right and left to get his horns between the trees easily. This accounted for the ability of a moose with a large spread being able to move through thick growth almost noiselessly,—a thing I had often wondered at. As he came to the trail, about 80 yards distant, I fired. He drew himself up stiffly, and I gave him the second barrel, when he fell. I was using a Holland 375 Cordite double rifle, and the bullet holes were only two inches apart, just back of the right shoulder. When we went up to him he was quite dead and in the cups of the palmation of his antlers the white frost shone out contrasting strongly with

the rich brown of the horns. His spread, measured as he fell, was 64⅝ inches.

I carefully weighed this moose after he was cut up and, allowing for losses of blood, etc., the nearest approximate weight I could arrive at was about 1,400 to 1,450 pounds. He was the biggest moose I have ever killed. Merrill says in his "Book of the Moose":

> The best Quebec head described by Ward spread, when thoroughly dry, 62½ inches. It has 14 plus 13 points, the breadth of palm is 14 inches. This head was secured by Col. John Caswell, an American (Massachusetts) sportsman, October 12, 1903. He was hunting on the Patapedia Lakes, Rimouski County, and the moose was brought from a distance of about two miles by a call in the early morning. Two shots from a .375 Holland double rifle, loaded with Cordite, effected the capture.

CHAPTER XVII

AIMS FOR VITAL POINTS ON GAME

Where to hold on game to kill is a question that is often asked. In order to aim correctly a good knowledge of comparative anatomy is of great value, but from a casual knowledge of the position of the vital organs and the general scheme of the skeleton we may draw conclusions which will enable us to shoot to kill.

The relative positions of brain, heart and lungs are similar in practically all mammals, while the bones of the skeleton are of the same general scheme.

I found in 1910, just before leaving London for my first trip to Africa, that several mornings spent with a friend of mine, a surgeon, at the South Kensington Museum, helped me greatly in the field. We first looked at the skeletons of the various animals commonly encountered and my friend pointed out to me the position of the heart and lungs of each and then examined the mounted specimens and determined where the

proper points of aim were for shots in different positions. I will try to show by a silhouette of the animals, with diagram of the skeleton and the positions of brain and heart indicated, where to shoot to reach these organs.

First let me say that I have never known an animal to go down instantaneously and stay down unless hit in brain or spine, and these two present such small marks that it is unwise in ordinary circumstances to try for them. Better to try to break the power of locomotion, the shoulders, and if we do not manage to totally disrupt the bony formation our bullets will pass through the thorax which contains the heart and lungs.

One point, which should be borne in mind, is not to consider the heart as the objective, but the fore shoulder farthest away from the shooter. This is my reason for advising such an amount of energy as 2,500 foot-pounds, for non-dangerous game and 4,000 pounds, or over, for dangerous, at distances of 100 yards, for it takes a heavy blow to drive an expanded soft point bullet through both shoulders and the heart and lungs. We will generally find that if the expansion has been sufficient the skin on the opposite

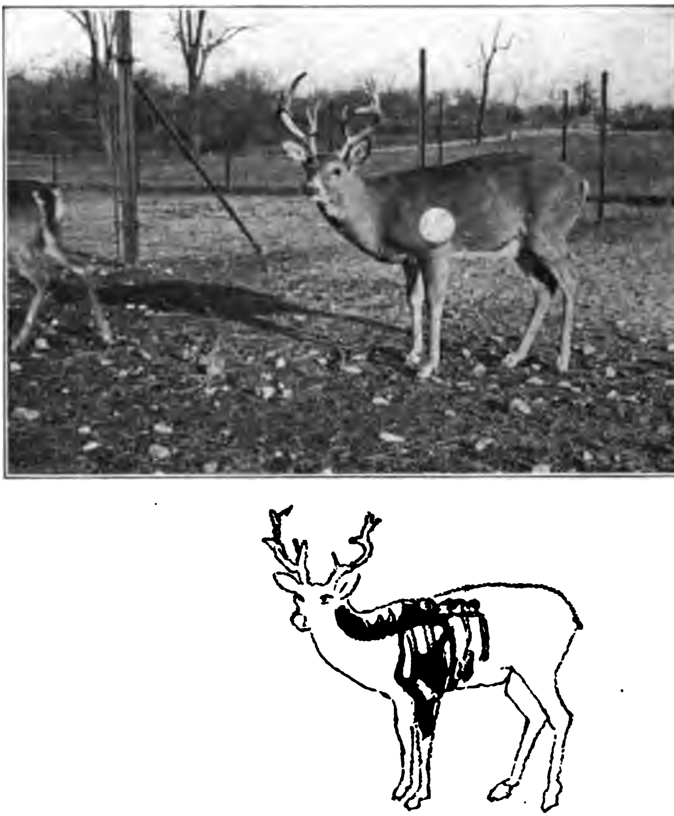


FIGURE 61. SIDE SHOT ON DEER; DIRECTIONS SAME AS FOR MOOSE. IF VERY SURE OF YOUR AIM, A SHOT AT THE BASE OF THE NECK TO BREAK THE SPINE MAY BE TRIED

shoulder will act as an elastic bullet stop, and few if any bullets will leave the body. This is as it should be, for then the animal will receive the entire energy of the blow and none will be wasted by passing through.

The old deer-stalking maxim of Lord Lovat is as good as any to follow. Sight on the fore leg of the animal nearest you and raise the point of aim until you see the front sight on the brown of the body and squeeze the trigger. This shot will be successful in the majority of cases, for nearly all our rifles will shoot high, as they are generally sighted to shoot into the center of the bull with the sights aligned at 6 o'clock.

We will also find that the softer tissues will transmit the shock of the blow laterally in addition to the force expanded forward to drive the bullet through, and so we will require our bullet to have force enough to carry the expanded point through bone and tissue, breaking and smashing everything on its way. Let us see what the average expansion of our bullets should be and what proportion of base and weight should remain when the bullet reaches the skin on the farther side of the animal.

As a rule with the lighter bullets and the nor-

mal soft point furnished by the cartridge manufacturers the expansion will be too great and there will not be weight enough left in the base to carry far enough into the animals.

A properly proportioned bullet should expand two diameters and at least one-half of its length should remain intact back of the expanded point to carry on; while there should not be a loss of over 20 per cent. in actual weight.

FIGURE 62, COMPARISON OF AMOUNT OF BASE REMAINING OF EXPANDED, SOFT-POINT, AND METAL-JACKETED BULLETS

The tearing power of the bullet depends largely on the mechanical action of the ragged edges of the expanded and disrupted jacket.

The claim made for the hollow-pointed bullet of explosive force, that it breaks up at least one-half the bullet, is only too well shown by the bullets cut from game of this type. I have recently seen two Ross 145-grain bullets cut from a grizzly in Cassiar in the fall of 1919 which show an expansion of nearly three-quarters of an inch but with the butt of hardly more than one-

sixteenth of an inch long, the whole remaining part of the bullet looking like a thickened shilling. The effects of the shots were as follows: Both hit the left fore shoulder blade and mushroomed, breaking the bone, but not having penetration sufficient to reach heart and lungs, they glanced back into the lungs and viscera. The bear went down to the first shot, went down to the second, and was finished at about 20 yards with a shot in the neck ranging back under the spine, bearing out the fact that the velocity was too great for the weight and construction of the bullets and that a 180-grain bullet would have been more effective.

So much for the average side-on shot. Another shot very frequently encountered is the quartering shot from the flank forward. This is a very sure and deadly one. We should follow the same general idea as the shoulder shot, endeavoring to traverse the body diagonally and break the opposite fore shoulder. Care should be taken to hold in front of the haunch and if possible aim for the spot just back of the ribs, remembering that the goal of the bullet should be the shoulder diagonally opposite.

As will be easily seen, the directions given for

the two foregoing shots apply to game standing side to or moving across at right angles to the line of fire and to those running away; both cases will give time for a second shot before the animal becomes dangerous.

When we are really called on to stop or turn an animal at close quarters we will find the head-on shot is nearly always presented. The frontal brain shot should rarely be attempted save at elephants, as the skull is presented at an acute angle and the bullets are apt to glance upward from the frontal bone and wound superficially. It is far better to hold for the left fore shoulder halfway up, when the heavy bullet will break the bone and stop the advance, or in the case of lion or bear for the point of the chin, holding low to enable the bullet to pass either through the lower jaw or below it, cutting the large blood vessels and breaking the spine.

It is well to remember that the first shots usually presented are generally quartering and a careful aim will obviate further trouble, for a broken fore shoulder with a raking shot, tearing the large blood vessels, will either turn or drop the animal. An instance of where the shot described did not come off as anticipated is as fol-

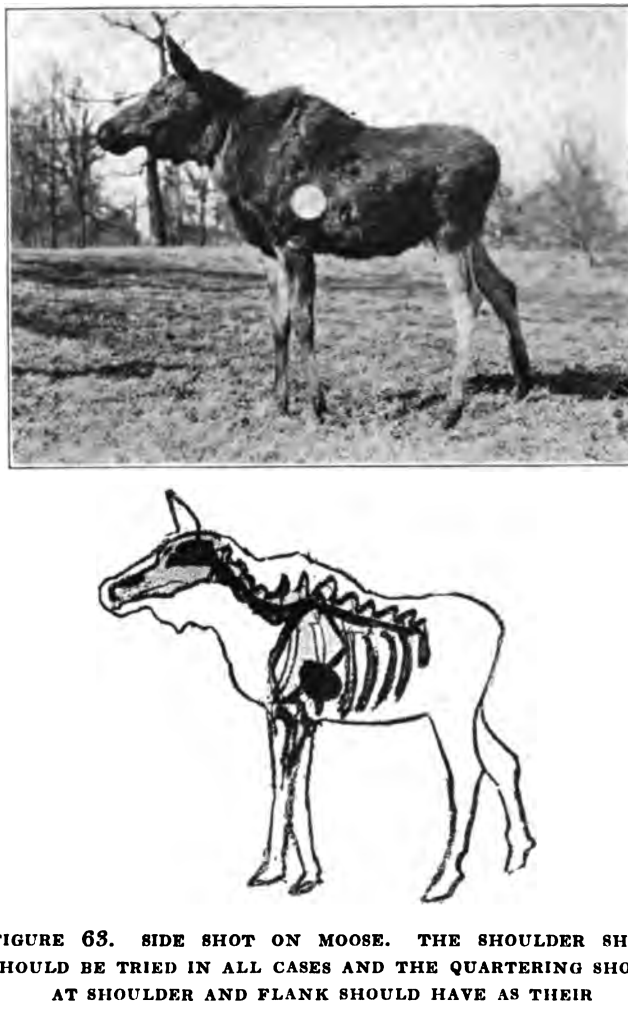


FIGURE 63. SIDE SHOT ON MOOSE. THE SHOULDER SHOT SHOULD BE TRIED IN ALL CASES AND THE QUARTERING SHOTS AT SHOULDER AND FLANK SHOULD HAVE AS THEIR OBJECTIVE THE OPPOSITE FORE SHOULDER

lows: In the fall of 1904 I had called a moose in the early morning and he had come up out of an alder swamp and stood facing me about 100 yards away, behind three dead cedars. He would not come farther and so I decided on the shoulder shot facing me. I fired twice and he wheeled and disappeared immediately in the bushes. On looking over the ground where we had stood I found plenty of blood and therefore waited about 10 or 15 minutes, or three cigarettes' time, and proceeded to follow the blood trail through the alders, which were pretty thick. After trailing him about 400 yards I heard the moose breathing and as I turned the next bunch of alders saw him lying down, evidently pretty sick. At the same instant he jumped up, faced me and reared, intending to strike me with his fore feet, but two very quick shots in the upper chest turned him over backwards about 12 or 15 feet distant.

On examination I found that my first two bullets had hit him, one merely cutting a gash along his side, the other hitting him just inside the point of the shoulder and following the muscles between the bone and the chest cavity and cutting the blood vessels but doing no serious damage, although half an inch either way would have

dropped him, as the rifle was a 375 double Cordite.

Here is one other instance of the flank shot quartering away. I had found a herd of eland on the Theba River, British East Africa, in 1911, and as there was a good head I tried to stalk them, but the country was too open and I could not get nearer than about 250 yards; then, too, the cows were between me and the bull, so I decided to stand up and take the shot as the herd wheeled, if a chance presented itself. This I did. The herd lumbered away and I fired at the bull who lurched forward and disappeared with his companions in a nullah or dry water course. I went up and found that he was dead about 75 yards from where he was hit, the bullet entering his left flank and ranging forward diagonally to the right fore shoulder which was broken. This was a running shot, at about 300 yards, which I paced. I was using a Springfield 30-caliber rifle with a soft-pointed bullet of 165 grains weight. The eland is the largest of African antelopes, weighing, I should judge, even more than a full-grown Jersey bull, and the little bullet had done the trick once more.

An instance of the spine shot at close quarters

occurred on the Athi River in 1910, and I cannot illustrate the shot better than quoting from my shooting diary written at the time. Percival was my white hunter and had been with Colonel Roosevelt for lion and with Prince Arthur and the Princess Patricia of Connaught just before he came with me on my first trip. The following is taken from my diary:

Tuesday, December 6, 1910. Stony Athi River; Temp. max. 98°, min. 66°. Started Safari at 6:45 A. M. from Tom Deacon's Zebra ranch, rode over Athi plains. P. suggested I had better try the 465 on Kongoni and Zebra as I had never used the rifle on game. Killed 2 Kongoni (Cokes Hartebeste), 1 Zebra (Burchells), when an Askari [soldier] came running up saying that the Neampara [head man] had sent him back with word that they had seen 2 lions in a douga and had halted the Safari and was watching. Left one gun-bearer with Kongoni and Zebra and rode about two miles, gun-bearers holding on to stirrup leathers and ponies' tails. Got to Safari which was drawn upon the bank of the dry bed of the Stony Athi. Men had been sent forward to watch, and they reported a lion and lioness still in the thorn scrub below. P. and I went on through the bushes for about one quarter

of a mile and found lion and lioness under a thorn bush; fired one shot at lioness when she went down and the second barrel of the 375 at the lion as he ran away at about 40 yards; hit him on the lower jaw, but he carried on. P. suggested we clean up the lioness who was growling and talking to herself pretty vividly, so placed P. on upper side of slope and sent two Syces on ponies around far side of river bed to head her off if she broke away, and then went in; it seemed as if she would never move. Just as I was sure she was totally disabled, she reared up to charge straight for me. Percival yelled, "For God's sake—" he didn't get out the word shoot, for I fired, hit her in neck and broke spine, soft point 465, distance 21 feet, went up, found first shot had hit too far back in shoulders. Measured 9 ft. 8½, nice skin. Followed lion who was laid up about 400 yards down river bed through scrub. About 30 of the boys started on the far side of a clump of thorn bushes, and drove same formation, P. uphill and Syces beyond on ponies. I thought he had gone, but when the porters had driven almost through the bush the lion jumped up, blood all over his mouth and mane, looked at me and roared, hit him twice with 375, both low and back, and as he turned gave him one with the 465 flank to shoulder, when he rolled over like a rabbit at about 50 yards. Great rejoicing, dance and shouting by the Safari! Two lions in 12 minutes

FIGURE 64. LION AND LIONESS SHOT ON THE STONY ATHI RIVER, BRITISH EAST AFRICA, DECEMBER, 1910; NOTE NECK SHOT ON LIONESS

second day out. Had to eat some lion heart which Sodak, chief gun-bearer, a Somali, brought me. The natives think that if the Bwana will eat the heart of his first lion it will make him brave and so they are more willing to follow him. It tasted very catty and God knows all the question I asked myself while we were going in was, "Why have you gone to so much trouble and expense to get into a place you can't get out of?" But when all was over, and at lunch after several whisky pegs, lion shooting seemed the finest sport and the easiest thing in the world. Lion, 11 ft. 1 in., small mane, first shot broke lower jaw and knocked out teeth; two more, 375, just back of shoulder and a bit high. Last shot, 465 soft point, hit just back of ribs on left side, tore fearful hole through chest, broke right fore shoulder, well expanded with plenty of butt left.

With buffalo, the head shot should never be attempted as the boss of the horns forms a bony protection to the front of the skull, and if there is time, it is far better to drop on one knee and try for the shoulder at the base of the neck. This will generally turn the animal. One should use the heavy rifle for this game in all cases, and load with soft-point bullet in the right and solid in the left.

The buffalo is a close second to the elephant as regards danger encountered in shooting, for both are met with in heavy brush or swamp grass, which makes it impossible for the shooter to move easily, while these obstacles offer little or no resistance to the animals themselves. I have been up against buffalo many times and of the five heads secured was charged at close quarters by three.

On the Burgoret River, Kenia West, British East Africa in 1912, I had missed a shot in long grass in the morning and had rejoined the Safari just before reaching the camp site. Near the stream, suddenly my gun-bearer said: "Look, Bwana, buffalo!" and in the edge of the forest across the stream I could discern the shapes of a herd of buffalo in the distance.

I immediately had all the porters drop their loads and lie down without noise or talking in the grass. I then crossed the stream and began the stalk. As I entered the thick bush I could just make out a fair bull at the end of a glade about 100 yards farther in, and so I began to stalk this particular animal.

I had come to within about 60 yards of him but the bush was too thick to get a clear view, so I

stepped to one side, evidently making a noise as I did so breaking a twig or some grass. At once another and larger bull got up from behind a log and stood looking at me not 20 yards away. I promptly fired both barrels just back of his shoulder and he went down, all four legs in the air, and gave the peculiar groan which old hunters say is the buffalo's death song. As I went forward with empty rifle I suddenly felt myself pushed or pulled to one side and a cow buffalo rushed past me, her right horn tip just grazing my coat.

I reloaded at once and as she turned to charge once more dropped her with the shoulder shot at very close quarters.

My gun-bearer, Sodak, had pulled me to one side as he saw the cow coming, and undoubtedly saved my life. The bull was dead, and his horns, now in the Explorers Club, measure 43½ inches.

When I reported the cow to the game commissioner, for it is against the law to shoot females, old Sodak kept reiterating, "But the Bwana had to shoot the cow that time," and both Cunninghame and Wooseman had a bit of fun speculating as to how many other cows I should have to account for. The record head comes from Uganda and is 53⅞ inches. It was shot by F. E.

Knowles, the Lieutenant-Governor of the province. It was he who gave me the wonderfully good photograph of Colonel Roosevelt which is now published for the first time as frontispiece to this volume.

For hippo, one rarely has any but the head shot presented and that a very small mark, but a solid bullet well placed will penetrate sufficiently, as the skull is rather spongy in substance and the bone not so resistant as that of animals not living in the water.

For rhino, we generally have the side shot at fairly close quarters and may either shoot for the neck or try the shoulder shot remembering the animal stands very low and that the heart and lungs are comparatively lower than with most animals.

In case of a charge the head is so fully protected by the horns that we are practically confined to a shot placed between the base of the neck and the shoulder and raking backwards and down, if he is close up. One should always employ solid bullets and the heaviest rifle for this work. A rhino will generally make a straight charge which can be side-stepped except in heavy brush, when he is likely to make a sudden rush

FIGURE 66. THE AUTHOR'S SAFARI COMING INTO FORT NYERI, BRITISH EAST AFRICA, 1911; IT CONSISTED OF 93 PORTERS

and is at times difficult to avoid, but he may almost always be turned by the neck shoulder front shot. His eyesight is not good, and as his horns are in the way, he depends almost entirely on scent to locate the danger; as a rule, he is accompanied by white egrets and the small rhino bird which feed on the ticks and insects which cover him. These birds will generally warn him of the shooter's approach and so one must stalk rather the sentinels than the rhino. When he first scents danger he will snort, throwing his nose into the air and stamping about as if trying to work his anger to a boiling point. Then generally he will lift his tail in the air, urinate, and when he has located the danger and finished his war-dance, charge straight for the objective.

I once had a small cow rhino charge five times through my Safari line and back. The porters dropped their loads and climbed the nearest trees, preferring the thorns they encountered to the chance of the rhino's horn; finally, after she had ripped a load of tents to pieces and a case of whisky had gone where it would not do any good, I took a hand and stopped the fun with a 465 bullet in her neck. I didn't want to shoot, but it was a case of my outfit or the rhino. That this

tendency to charge is congenital is well shown by the following: On my return to Nairobi from my first trip, I saw Tarlton, who I had previously met on the Tana River several months back, bringing in a baby rhino. He had shot the mother and had the little fellow in a sort of sling made from two tent flies, with holes cut for his legs and a long pole on top. When he refused to walk, he was carried by porters in this improvised sling, and when he struggled too much he was put on the ground and the pole held above so that he could be steered properly. Tarlton told me the baby had grown enormously and was three feet to the shoulder and weighed about 600 pounds, and asked me to come out to his ranch, some six miles from Nairobi, and see him.

Accordingly, Percival and I rode out to see the infant prodigy, which had become quite tame and followed his keeper, a Kikuyu boy, about like a dog. When we arrived, Tarlton was away looking to some sisal fields which he had just planted, and the baby rhino was out at exercise. Giving our ponies to a boy, we sent for the rhino and in the meantime looked over Tarlton's menagerie, for he is a collector for many Zoölogical Gardens, and his ostrich corral, where he had

some fine young birds in high wire inclosures with posts about six feet high.

Presently the rhino hove in sight, his boy feeding him with some grass and leaves and guiding him with a light switch. We looked him over and he evidently did not recognize our scent, for he charged viciously, first at one and then at the other. Now a rhino, even if he is a baby and has only three or four-inch horns, is not to be trifled with, so Percival and I took to the fence posts of the ostrich corral and shouted for Tarlton, who came up.

He swears he found us perched on the posts, first being picked in the rear by the beaks of inquiring ostriches, and then charged in front by the harmless baby, and told the story to good effect at Nairobi. The rhino was finally beaten off with sticks and we had a very pleasant lunch, but it goes to show that a rhino will charge from birth to the end of his life.

One more anecdote of our friend the rhino. A. B. Percival and Wooseman, both game rangers, were marching north in the Meru country in Africa and had pitched their camp at dark near a water hole. The Bwana's tent was put up in a clear space which later turned out to be an old

rhino path to the water. In the middle of the night Percival fortunately left the tent and Wooseman describes what happened as follows:

There was a great crash and the tent was ripped down. My first impression was that a cyclone had struck it. When I crawled out of the débris I saw an old rhino disappearing in the moonlight with part of the fly gracefully draped over his horns and streaming out behind. I immediately thought of Percival and examined the wreckage and found the cot and canvas of the tent smeared with heavy clots of red. Poor old "P," he had been done for, and these were part of the remains. Suddenly Percival appeared looking for me. He was all right, and the blotches of sticky red were the remains of a box of strawberry jam from our supplies placed under Percival's cot for safekeeping from the cook and tent boys.

Wooseman was killed in France bravely leading his men in 1915.

With the elephant, the head shot is one sure and certain way of avoiding trouble, and a careful study of the animal's skull will show us that the brain measures some six by eleven inches. It is a good plan to imagine a line drawn diagonally from each eye to the orifice of the opposite ear.

FIGURE 65. ORYX BIESA SHOT ON THE GUARAN DARE RIVER, BRITISH EAST AFRICA, 1911; MALE; LENGTH OF HORNS, 39¼ INCHES. ONE SHOT, SPRINGFIELD RIFLE, 180-GRAIN SOLID BULLET, 210 YARDS

Where these two lines intersect is the point of aim, and we should try to put the bullet on that spot from whatever angle we stand, using only our heaviest rifle and solid bullets. The shoulder shot is also effective as is a shot either in the flank ranging forward, or one from the back to strike at the base of the skull; but work after elephant is generally in heavy grass or bamboo, and as the herd almost invariably breaks up wind, it is far the best plan to make sure of your shot and try for the brain.

The front shot is not so easy, as when charging the trunk is lifted and the head lowered. Then, too, the structure of the skull of the African elephant is thicker over the frontal and parital bone than that of his Indian cousin, and is more difficult to penetrate. Nothing but the heaviest rifles should be employed for this work, with solid metal-cased bullets, as Mr. Elephant is the biggest and most dangerous game, requiring a weapon capable of delivering a powerful blow which even if it does not hit the brain will deliver a shock sufficient to paralyze the animal and give the shooter either time to escape or to get in a second shot.

The accompanying diagrams will, I hope,

clearly illustrate the points of aim to be taken for various animals. The shots advised have all been proven and the results may be relied on in practically all cases.

There has been a great deal of rubbish written about using a bullet which expands and spoils meat for purposes of food. The first consideration should be to kill quickly and neatly without causing undue suffering. The second is to get food. Very little meat is rendered unfit for use by bullet holes; it is, however, far better to lose a small portion of the meat than to have a lot of poor brutes roaming around with wounds which will eventually cause death. With the heavier game the killing resolves itself into the saying, "Get or be got." Nevertheless, it is true that, for certain purposes, where it is desirable not to spoil skin or skeleton for a museum specimen, we should rely more on placing the shot than on general shock, especially in the case of the smaller mammals.

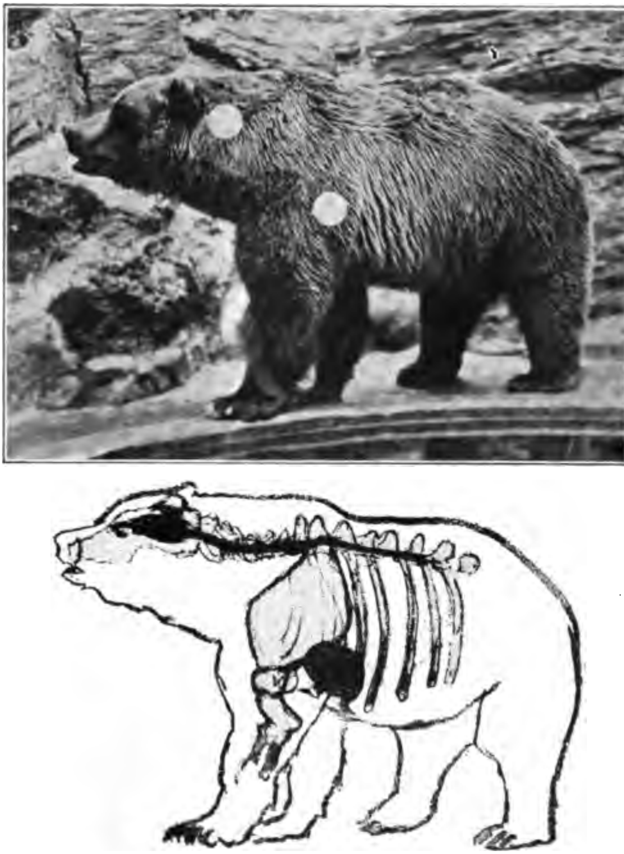


FIGURE 67. SIDE SHOT ON BEAR. THE SHOULDER SHOT IS PREFERABLE, UNLESS THE RANGE IS SHORT, WHEN THE NECK SHOT MAY BE TRIED

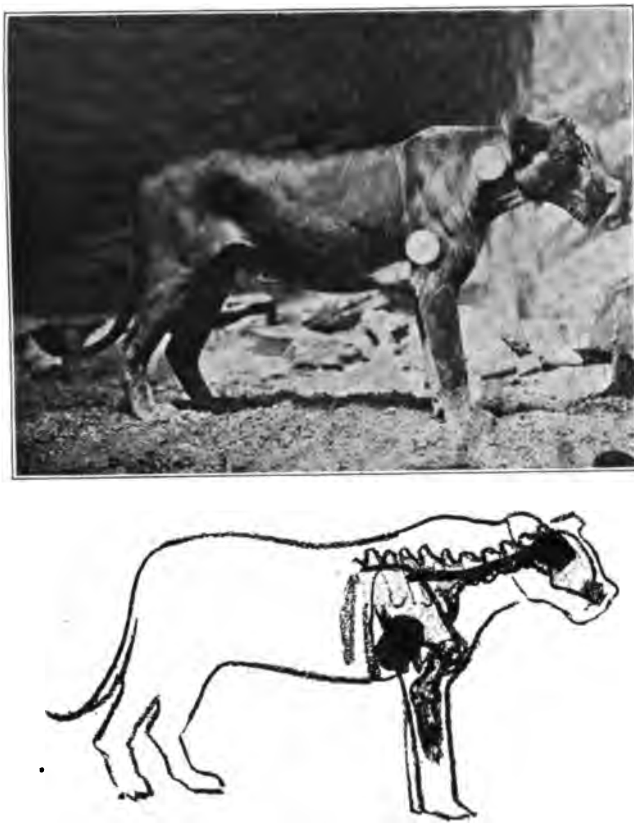


FIGURE 68. SIDE SHOT ON LIONESS. THE SHOULDER SHOT SHOULD ALWAYS BE ATTEMPTED TO TRY TO BREAK DOWN LOCOMOTION AND PREVENT A CHARGE

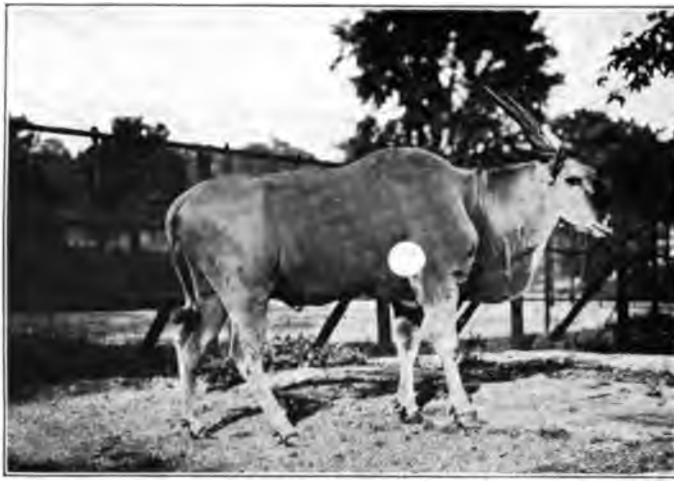
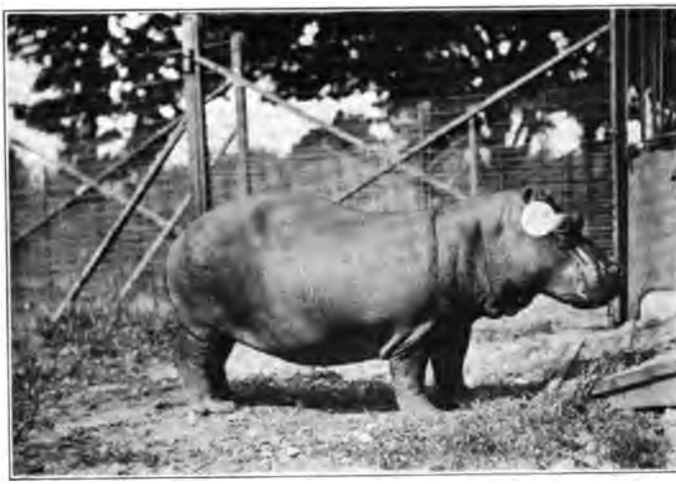


FIGURE 69. SIDE SHOT ON ELAND. IT WILL BE SEEN THAT THE HEART AND SHOULDER BLADE ARE APPARENTLY FARTHER BACK, OWING TO THE HEAVIER DEWLAP, THAN IN MOST ANTELOPES; THIS FACT SHOULD BE BORNE IN MIND



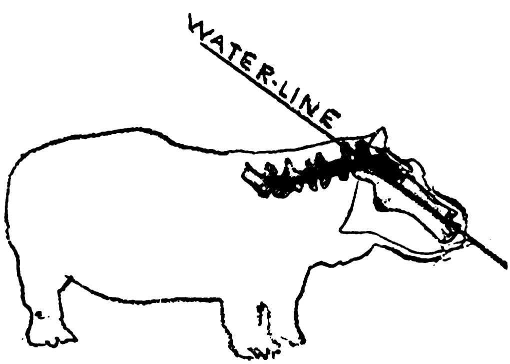


FIGURE 70. HEAD SHOT ON HIPPOPOTAMUS. THE BRAIN SHOT IS THE ONE NEARLY ALWAYS PRESENTED, GENERALLY IN THE WATER. AN ACCURATE RIFLE OF GOOD PENETRATION IS ESSENTIAL

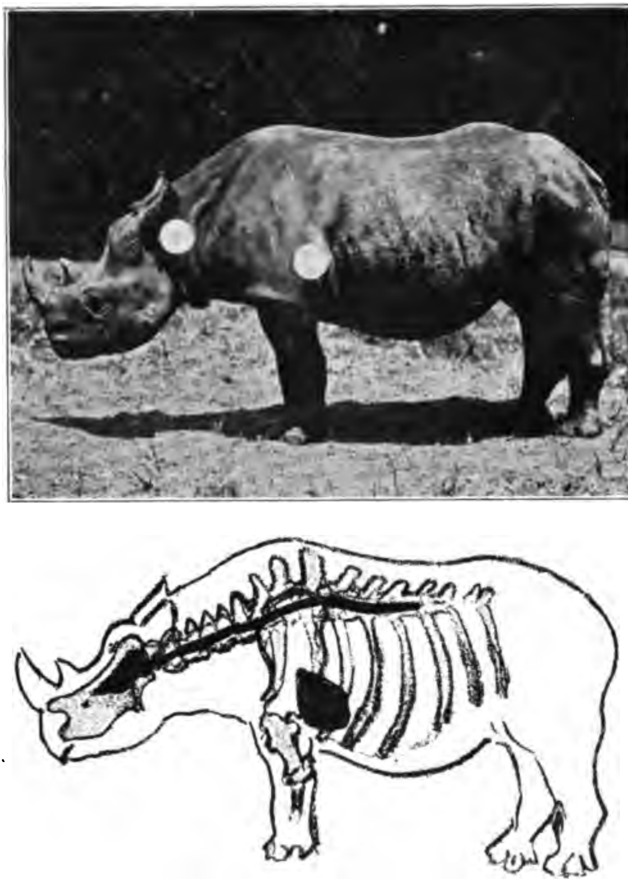


FIGURE 71. SIDE SHOT ON RHINOCEROS. THE NECK IF CLOSE ENOUGH; OTHERWISE THE FORE SHOULDER, BUT IF THE LATTER IS TAKEN, ANOTHER SHOT WILL BE NECESSARY TO FINISH

FIGURE 72. HEAD-ON SHOT ON RHINOCEROS. ONLY THE SHOT AT BASE OF NECK AND SHOULDER SHOULD BE ATTEMPTED, AS THE BRAIN IS SMALL AND IS PROTECTED BY THE HORNS. THIS SHOT ALSO APPLIES TO CAPE BUFFALO

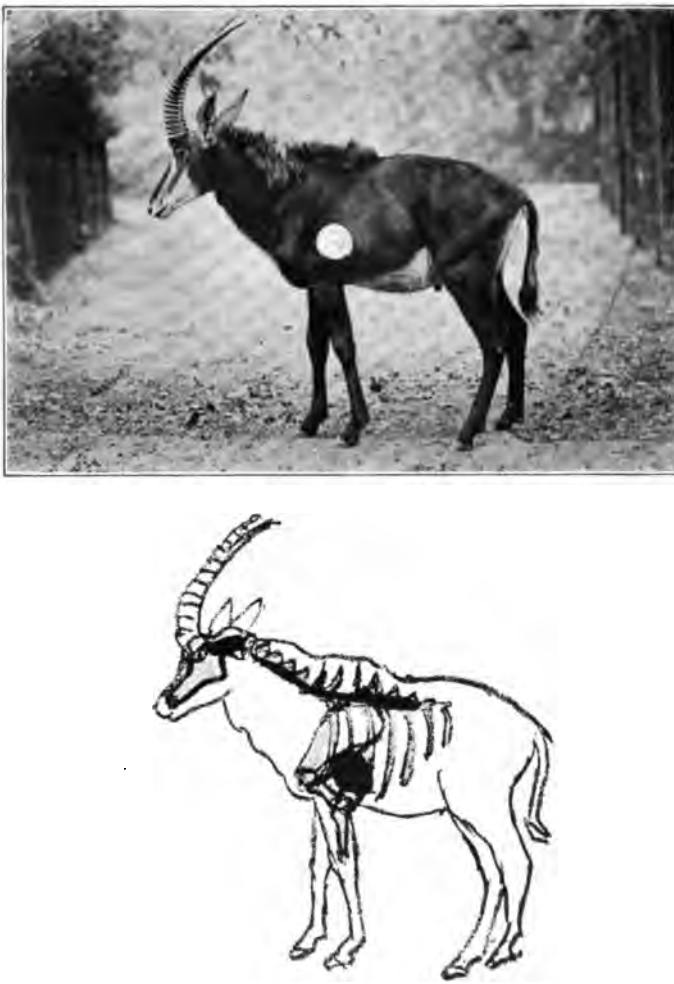


FIGURE 73. SIDE SHOT ON SABLE ANTELOPE. SHOULDER AND QUARTERING SHOTS ARE THE RULE

FIGURE 74. SIDE SHOT ON ELEPHANT. THE HEAD SHOT IS TO BE TRIED FOR IN ALL POSSIBLE CASES; THE SHOULDER SHOULD BE FIRED AT ONLY WHEN THE HEAD IS NOT VISIBLE ON ACCOUNT OF GRASS OR BRUSH

APPENDICES

APPENDIX I

HISTORICAL SKETCH OF THE EVOLUTION OF THE RIFLE

If we revert to the very beginning of weapons of defense, we may start with the stone thrown by hand and follow the development of mechanical means of transmitting power through the various stages of sling, bow and arrow, and crossbow—to the later types of crossbow which replaced the quarrel or short arrow with a leaden slug. With the introduction of gun powder, a tube was introduced on a shoulder rest or stock of the bow and the ball placed on the charge of powder which was ignited by a slow match or wick. This in turn gave way to the wheel lock, which was replaced by the application of flint and steel ignition to the sporting gun. Probably the highest development of the flint-lock was reached about 1830, and those made by Joseph Manton, of London, were exquisite pieces of workmanship.

In America the first flint-locks were smoothbore, carrying a round ball about 32 calibers in diameter for convenience of transportation. This small bullet was effective against the non-dangerous eastern game, and, on account of the long barrel generally used on the weapon, was accu-

rate up to 150 yards. With the exodus of the trapper and pioneer to the western prairies, where he encountered buffalo, bear, and larger animals, we find that the bore of the flint-lock rifle was increased to about 45 or 50 calibers, and, also, for ease and convenience in carrying on horseback, as well as in loading, the length of the barrel was decreased. This shorter large-bore rifle was known as the Mississippi Yeager, and was used by the pioneers in the Far West. In the northwestern part of the United States the bore was still further increased, and we find many examples of rifles of 70-caliber or more. These rifles were evidently used against grizzlies and buffalo. It is perfectly certain that the stories that we hear of the marvelous accuracy and range of these weapons are mythical and have been greatly exaggerated in being passed down to younger generations. Probably more rifles were manufactured in western Pennsylvania than in any other portion of the United States in these early periods, and contests were held between the various villages and towns in order to demonstrate the superiority of certain sections in the use of the weapon.

Cooper, in his "Leather Stocking Tales," has drawn the long bow about as far as any one can in regard to the flint-lock rifle, and yet it was accurate, as I have said, at short ranges. Only last year (1919) I saw Mr. Dillon of Philadel-

phia at the National Rifle Association Meeting demonstrate that with a flint-lock rifle of the earlier period he could load, prime, and fire the piece in 30 seconds and hold nearly all his shots in a 10-inch circle at 100 yards.

Although the percussion rifle was introduced in the early part of the nineteenth century, it was not generally adopted by the men of the Far West, who found difficulty in obtaining caps for the rifle and preferred to trust to the flint-lock. In the East, however, it was brought to a fine point of perfection, and many noted rifle makers made exceptionally fine weapons—Billinghurst-Perry, Reuben Harwood, Schalke, Zichaug, and others. These rifles were of 38 to 50 caliber, and used a heavy powder charge compared to the flint-locks. They were extremely accurate; in fact, far more so than many of the breech-loaders. Until recent years—1880 to 1889—many were still in the hands of target shooters, especially for long range, for in the first metallic cartridges for breech-loaders there was great difficulty as regards ammunition. The natural descendant of these extremely accurate rifles is seen in the 32/40 and 38/55 single-shot target rifles of to-day.

The percussion rifle was in use here in America until the time of the Civil War, when the breech-loading weapon, taking a metallic cartridge with a charge of priming or fulminate con-

tained in the cartridge case, was introduced; this in turn gave way to a rifle, the Volcanic Magazine, the invention of Wesson of Springfield, Massachusetts, and Henry, which was in turn superseded by the Henry 44-caliber, rim-fire, 16-shot repeater. These patents were acquired by the Winchester Repeating Arms Company, and in 1866 the first Winchester Repeating Rifle under that name was manufactured. From that time this company seems to have held its own in the matter of repeating rifles until the introduction of the present bolt type.

There was a type of rifle evolved during the Civil War, or just previous to that period, which was a semi-breech loader; that is, the rear portion of the barrel was dropped in the action frame and a charge of powder and bullet was inserted, either separately or in the form of a paper cartridge, without, however, any primer. The ignition was supplied by a cap placed upon a nipple at the breech of this falling block. Of this type, probably the best known were the Burnside and the Sharpe patterns. The Sharpe pattern merely had the addition of a firing pin in the falling block and inserted the cartridge in the breech of the barrel proper. This cartridge had a primer located in the center of the case and contained the powder charge proper and the bullet fixed in the mouth of the shell. Sharpe followed the practice of the Western hunters and employed a

FIGURE 77. SHARP'S "OLD RELIABLE" 45-CALIBER RIFLE SHOOTING 126 GRAINS OF F. G. POWDER AND 525-GRAIN BULLET

FIGURE 78. WINCHESTER 44/40, MODEL 1873

heavy bullet of large caliber with a considerable charge of powder, thus insuring range and smashing power, a practice continued until the introduction of the small-bore, high-velocity rifle.

As these rifles were mainly for use on the western prairies and were carried on horseback, a heavy barrel was employed, and the famous buffalo gun known as Sharpe's "Old Reliable" was evolved, the weight of which was 14 to 18 pounds. We still find specimens that have been used on the western plains shooting a 45-caliber bullet of 400 grains weight, with a powder charge of from 100 to 130 grains of black powder, while the same rifle was equally famous at Creedmore, Walnut Hill, and other eastern ranges, for long-range shooting.

It was not until 1886 that the Winchester Company brought out a repeater to take these cartridges as well as the 45/70, which was used in the Government Springfield, the regulation arm with a portion of the United States forces until the adoption of the smokeless, high-velocity, small-bore in 1896.

The first repeating rifle to handle a small-bore smokeless cartridge of American origin was the Winchester 30/30 model of 1894, and it was immediately a great favorite. Colonel Roosevelt used it early in the 90's and commended it highly.

With the adoption of the Krag-Jorgensen by the War Department, the 30-caliber Krag-Jor-

gensen cartridge immediately became popular, and still is as a game getter. Commercial rifles are made for it, but nearly all the rifle manufacturers still cling to the light 30/30 and claim almost miraculous powers for their special cartridges of this type, which are, however, too weak for any game except deer.

The English double rifle has never been popular in this country, probably due to the fact that nearly every farmer's boy had been brought up from childhood and had become accustomed to the long single-barrel weapon. Then, too, there was very little use for a smashing blow, for the game was not dangerous in the more populated districts.

I think that the familiarity of former generations with the rifle rather than with the shotgun has given rise to the idea that Americans and American rifles were invincible. Unfortunately, as the game has disappeared and the chances to the small boy for indiscriminate practice have lessened, just so much has the general knowledge of the weapon decreased, and if we are to preserve a reasonable amount of skill with the weapon, we must depend on target practice and competition, beginning with the school boy and ending when a man is past middle age. The facilities of practice and attaining skill with the rifle have been fostered by the National Rifle Association, and through its efforts allowances have been made by

the War Department to maintain and equip civilian rifle clubs throughout the country. It is to be hoped that enough interest will be taken in rifle shooting in the near future to provide at least the nucleus of men competent to act as instructors in case of emergency to such forces as we may find necessary to raise for the protection of the country.

Rifling, or the grooving of the interior of gun barrels, was probably introduced in Germany about 1550. The function of this grooving seems to have been to make loading easier rather than to have any specific effect on the bullet, and it was not until the introduction of spiral grooves and a round ball with a belt cast on its circumference which took the groove that any attempt was made to impart a rotary motion to the projectile. The development seems to have been more definite with the introduction of the conical bullet, and the grooves were multiplied and the base of the bullet made hollow so that the force of the explosion of the powder would expand it into the grooves and impart a rotary motion to the bullet on its long axis during flight and keep it point foremost. It thus resists any tendency of this long cylinder to overturn or keyhole; as the spinning of a top will cause it to preserve its balance while revolving upon its point, so the spinning of the bullet will keep it traveling point foremost in the air.

In the manufacture of rifle barrels the bar of steel is first smooth bored with a hole the diameter of the caliber desired. The exterior of the barrel is then turned true to the axis of the bore and grooves are cut in the interior surface in a spiral channel which leave certain ridges or uncut portions of the barrel raised spirals. It sometimes takes as many as 150 distinct cuts to bring the grooves to a depth of four one-thousandths of an inch. The chamber is then bored in the breech end of the barrel to take the cartridge case, and the rifle barrel itself is threaded to fit into the action.

It will be seen that as these raised spirals engrave or cut into the surface of the bullet, and the base of the bullet by the force of the powder, is expanded to fill the groove with a gas-tight fit, a rotation equal to the spiral of the grooving will be imparted to the bullet. Now, in as much as the longer and heavier the bullet is, the more apt we are to find air resistance at the point irregular, and also as the slightest irregularity of delivery of its base from the muzzle will develop a greater tendency to tumble or keyhole, with increase in length and weight of the bullet we must increase the rate of rotation in a given distance to make it travel point foremost.

The barrel once fitted to the action is then equipped with sights and is stocked. It is then generally bore sighted, that is, the sights are

aligned on a known spot and the center of the bore on another at a short distance away. Many rifles are then turned over to the customer without further tests; but with the better qualities, and by those makers who really guarantee the accuracy of their weapons, the complete rifle is first shot with a proof charge in excess of the service or usual charge to be used, and also shot for alignment and elevation of the sights. The shooting is generally done from a muzzle and elbow rest by an expert shot, and in the case of very fine weapons they are placed in a mechanical rest and shot for groups generally consisting of 10 shots at 100 and 200 yards. The cartridges used in testing must be loaded with extreme care and each must be as near the counterpart of the other as possible, or wild shots will be the rule and no group of any decent dimensions will be obtained.

In order to obtain a standard of cartridges used, it is necessary to know the velocity and breech pressure produced by a certain load; this is obtained by the use of two instruments. One is the chronograph to obtain the velocity of the bullet; it consists of a rest and a target of steel; across the muzzle of the rifle is stretched a fine wire which is electrically connected with a recording instrument, as is also the steel plate or the target. When the rifle bullet leaves the muzzle, it breaks the wire and interrupts an electric

circuit; when it strikes the plate it closes the circuit again. As the time that the bullet is in flight between these two points is recorded on the instrument, the velocity is easily obtained in feet per seconds.

The pressure exerted by the charge of powder on the interior of the barrel is obtained by another instrument known as the crusher gauge, which is operated as follows: A hole is bored in a test barrel chambered for the cartridge, and when the charge is fired, the force is transmitted through this opening to a piston, which in turn acts on a cylinder of lead or copper and crushes or strikes it. The cylinder is then measured and the amount of compression from its original length carefully computed. The consistency of the metal in the cylinder being known and also the force required to compress the cylinder a given amount, the force exerted by the powder in the chamber of the barrel is readily estimated.

The powder used in the early rifles was of the variety known as black, and was composed of a mixture of charcoal, saltpeter and sulphur. Although the quality of the ingredients was improved and the various quantities of each component slightly changed, the fundamental principle of combustion remained the same. It was not until about 1859 that a practical smokeless composition was obtained by Schultze, a German chemist. At the present day practically all rifle

powders are of the smokeless variety. They are made by nitrating either pulp, cotton, or a mineral jelly, their force being regulated by their chemical composition.

APPENDIX II

POPE RIFLE BARRELS

By H. M. Pope

By profession I am a mechanical engineer and a skillful workman; for recreation and by preference, a "rifle crank." I first made a barrel (entirely on a foot lathe) because I could not buy what I wanted; i. e., a .25-caliber, which I made in 1887, before this size was manufactured. My first charge was a straight shell holding 25 grains of powder and a 100-grain bullet, then a shorter one with 20 or 21 grains of powder and 85-grain bullet. Finding the making of a sufficient number of these shells on a foot lathe an arduous task, I rechambered and swaged down a .32/20 shell. I used this shell for some time, but on making my first muzzle loader, I swaged down a .38 extra-long, center-fire shell, holding 30 grains, and using bullets up to 120 grains. With this rifle I did my best shooting under National Rifle Association rules. Being troubled with bursting shells, I finally swaged down .32/40 everlasting shells, using 35 grains. This did good work muzzle loading, but had passed the limit for ac-

curacy for breech-loading with black powder. Shortly after this I accidentally injured my barrel and abandoned this rifle for a 18-pound rifle with set triggers, the state of my pocketbook at prize matches giving an unanswerable argument that this gave better results than the lighter arm, and later experience fully bears this out, and I find that I can still shoot a "practical" rifle with the rest, some "arm over your head" cranks to the contrary. (Proof, five dead deer with five cartridges, standing and running all in thick woods at usual distance.) The conditions of target shooting and field shooting bear no resemblance to one another, the most difficult change being not the change in arm, but the change from a deliberate aim at a target to the snap shot at game. Therefore when you shoot at a target use every refinement known to increase your scores, as almost every refinement known for target use is impracticable in the field or woods.

During the period above mentioned I became interested in, and thoroughly convinced that, the so-called Schalke system, devised by Wm. Hayes and Geo. Schalke, possessed advantages for offhand shooting that placed it far in advance of any other system of loading. This system I adopted, improving on Mr. Schalke's method of manufacture, and altering somewhat the form of cut, though retaining the essential

features. The above mentioned heavy rifle, as well as the last .25 caliber, were so made. Their performance was so good that I had to fit out my intimate shooting friends, and their improvement in shooting was so marked that I began to be besieged by outside parties to make barrels for them. This, for a long time, I refused to

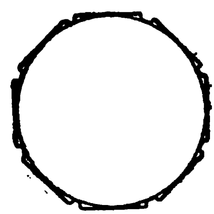


FIGURE 79. POPE RIFLING AS USED IN SCHUETZEN TARGET RIFLES

do, but finally these inquiries became so numerous, and Mr. Schalke's death occurring about this time, I consented, with the result that my barrels are now in the hands of the most expert off-hand shots in the country, and are making scores that are unsurpassed, and every man who shoots a Pope improves his scores. Don't believe me, but watch the papers and see if this is not so.

The Pope system, so called, is, as previously stated, nearly the same as the Schalke, the difference being in the shape of the cut, and that my barrels are cut to correct shape, while Mr. Schalke's were leaded. Mr. Schalke's rifling had eight flat grooves and eight narrow lands, with

sharp corners to grooves. My rifling is here shown (see Fig. 79). It has eight wide grooves, which are on a radius about three times the radius of the bore, and has the corners rounded out, so dirt is easier removed, and it is cleaner in use. This groove is cut just deep enough to clean the bore in center and give a depth at corners of about .004 inch, which is about one-half the depth of the Schalke, but which is of ample depth, and works cleaner, and leaves less to depend on on upset of the bullet, and is therefore more reliable. The lands are very narrow (about one-fifth to one-sixth the width of the groove). The bullet is made with a base large enough to fill grooves completely, and the body of practically the same diameter as the bore. This gives a form that is gas tight, loads very easily (being assisted in this by the narrow lands and choke bore), and on upset, instead of the body of the bullet meeting only sharp lands and these cutting into the body of the bullet more or less unequally, it is immediately held to place by the nearly flat center of the broad grooves, and swells out into grooves equally and perfectly central; consequently is accurate.

In this system a false muzzle and starter are used, and the lubricated bullet, seated from the muzzle, the shell with powder being afterward inserted in the ordinary way. In doing this the

labor is very light, as the shooter has to handle nothing over a few ounces weight, the rifle standing in the loading stand. By the simple act of pushing the bullet home the sharp flat base of the bullet cuts the dirt down behind it, and does so exactly alike each time, giving a uniformly clean barrel without the labor of cleaning. This is also less labor than the ordinary way of seating a greased bullet in the breech, having to invert the rifle and generally sustaining its weight while so doing. The result of these things is that we attain all the accuracy of patched bullets, and in ordinary hands more, without the labor of cleaning.

Other things being equal, the man who tires himself least does the best shooting in the long run, and if this is accompanied by increased accuracy of the rifle, he has a great advantage over his fellows who do otherwise.

A properly made barrel, loaded in this way, will shoot 10-shot groups at 200 yards that will average about 1¼ to 1½ inches less in diameter than the same or an equally good barrel shot dirty, bullet seated from the breech, while one using bullets seated in the shell is so far out of the game as to have no chance whatever on a string of any considerable number of shots, if otherwise he is an even match for his competitors.

One and one-quarter to 1½ inches does not sound much, but on the fine ringed targets now

in use it means *points*. I have before me a good muzzle-loading group, .32-caliber, 10 shots, 200 yards. On German ring target it counts 250. Another group, shot breech loading, bullet seated in the breech, same load, is but one inch larger in diameter and is the best group I ever saw shot under these conditions. It counts 245. On the Columbia target the scores are respectively 12 and 21; on the Standard American 120 and 115. The difference between *average* groups is still more marked, averaging fully seven or eight points on German ring target. On this no comment is necessary.

For steadiness in shooting, I have fired 130 consecutive shots in 10-shot strings, measuring from centers of groups 104 inches, an average of exactly .8 inch per shot. The largest group was 3.75 inches across from center to center of outside shots, and measured 9-11/16 inches. The smallest group was 1.8 inches across and measured six inches. All but two of the shots would fit into a three-inch circle.

A bullet loaded from the muzzle will always have an advantage over one loaded from the breech, for it will have a perfect base, as the lands *cutting forward* into the bullet leave it nearly perfect. Contrast it with a bullet seated in the breech by means of a bullet seated in the ordinary way. Here the lands *cutting backward* into the bullet *drag the burrs behind, leaving an*

uneven and serrated base. If this bullet is not perfectly centered these burrs will be longer on one side than on the other. As these burrs leave the muzzle, the gas escapes first from the short side, tipping the bullet to the opposite side, in which it is assisted by the longer burrs holding the bullet back; the result is an uneven, wobbling flight. *The greatest essential for perfect shooting is to deliver the bullet perfectly from the muzzle;* that being done, atmospheric conditions and gravity alone govern its flight; the result is accurate shooting.

To illustrate, a group was shot at 200 yards, machine rest, with as perfect bullets as I could select, another on same holding with bullets very badly mutilated at the point; these two grouped closely, a three-inch circle holding all. Another group was then shot with bullets very slightly filed on one edge of the base, but otherwise perfect; this caused imperfect delivery, and the group was eight inches in diameter. Weather conditions were good.

The base band of my bullets is broad and sharp, and of full size; the starter centers it perfectly, and fits it to rifling with a perfect base; the shape of the grooves hold it central on upset, and it delivers perfect from the muzzle. No other method will do this.

My barrels are all (unless specially ordered) cut with a gain twist, and are so bored and rifled

as to have a slight, but gradual, taper from breech to muzzle. This, besides keeping bullets perfectly under control, in connection with the narrow lands (which cut through the bullet easily), makes loading very easy, and very materially increases accuracy. A bullet pushed through from the breech is tight all the way, there are no loose places, and this result is attained by close, careful workmanship, no emery being used; the result is a barrel with a long life. Whenever practicable I chamber and make all cross-cuts before rifling; then I fit a bushing to the chamber and bore and rifle it with the barrel and false muzzle. As the rifling is then the last cut made in the barrel, I am absolutely certain that there can be no burrs across the grooves, a very common fault.

The advantage of the gain twist are two: First—The twist being less at the breech, gives less friction to the bullet; it therefore starts easier and quicker, giving the powder less time to burn on in front of the chamber, which therefore fouls less than in a barrel of uniform twist at the same necessary muzzle pitch. Second—The slight change in angle of rifling, in connection with choke boring, effectually shuts off any escape of gas and prevents gas cutting, which is another cause of imperfect delivery.

The advantages of the Pope system are briefly summed up as follows:

1—Accuracy. 2—Light labor. 3—Seating the bullet centrally without deforming the base, and fitting it perfectly to the bore. 4—The shape of the grooves holding the bullet central on upset. 5—Non burning-on qualities of the gain twist. 6—Perfect workmanship. 7—Ability to load from either the breech or muzzle, and to clean and inspect from the breech. 8—The ability to shoot any charge desired by inserting shell first, and loading both powder and bullet from the muzzle.

To produce the quality of work that I do, the methods employed in factories producing work in large quantities are impossible; that is to say, that this method of interchangeable parts must leave some leeway for slight inaccuracies to insure parts assembling. In my work such looseness of fit would be fatal to the results attained. False muzzles, for instance, it is utterly impossible to make perfectly interchangeable, neither is it possible for automatic machinery to produce the same quality of work as a skilled workman with brains behind. The automatic machine does more and does it cheaper, but the quality is not there. Therefore I do all nice work by hand, in the very best manner I know how. Nothing is slighted. This is slow work and takes expensive men. Naturally I cannot compete with factory work in price, but, quality considered, my price is very low.

The Pope muzzle loading outfit consists of barrel, false muzzle, starter, ramrod, Pope special muzzle-loading mold, and lubricating pump. Barrels will be furnished of almost any length and weight, within about 3 to 6 ounces limit of variation up to 8 pounds, 2 ounces, for

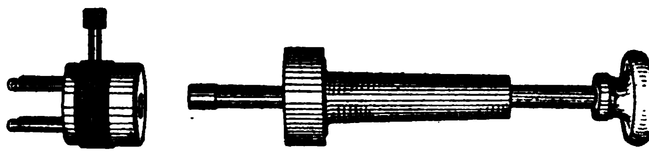


FIGURE 80. POPE FALSE MUZZLE AND BULLET SEATER

32-inch, No. 4 Octagon, .32-caliber barrel. I consider for 200 yard offhand work a barrel of about 7¾ pounds, 30 inches long and round as the best adapted. This I consider my standard, and recommend it as giving the best average results. For caliber for offhand work I prefer a .28, .32 or .33.

The weight of powder charges are the drawn shell full. This can be decreased by the use of everlasting or special shells, or by using less powder and an air space. Weights of B. L. bullets are those intended to seat in the shell. Barrels are cut with a pitch correct for the bullet they are intended to use. Shorter bullets can be made in a barrel cut for the long one, but not the reverse. It is oftentimes better to use the lighter bullet. Unless specially ordered I shall use my own judgment in cutting the barrel.

Calibers and Weights

Caliber	Powder grains	M.L. Bullet grains	B.L. Bullet grains	200 yd. Guarantee inches
.25	26	98	86	3½ and 3
.28	30	118 and 138	108	3 and 2½
.32	47	180 and 200	165 and 185	3 and 2½
.33	47	195 and 218		3 and 2½
.38	55	277 and 330	255	3 and 2½
.39	55	265 and 343		3 and 2½

Note.—The .33 and .39 calibers are recut from old .32 and .38 barrels and are adapted to muzzle loading only.

It will be noticed that two guarantees are given as to the size of the group at 200 yards. There is absolutely no difference in the qualities of barrel or workmanship. I have a long trip to make to test, and in my guarantee have to make allowance for adverse weather conditions, sometimes having to make several trips to the range to secure the desired results. I never alter a barrel in testing, it is a matter of ammunition only. If tested you see what has actually been accomplished with fine appliances, and know exactly what load did it. If untested you, unless very expert, can hardly expect to equal at once the results of my machine rest, and may have to do some experimenting (when you become accustomed to the system, not before), to determine the best temper of bullets, etc. You are liable to get as close a group on one guarantee as another, as it is largely a matter of weather conditions. If weather is good I get close groups; if weather is cold and wind tricky they are not so

good. It is perfectly obvious that I cannot guarantee to furnish as close a group as the barrel is capable of shooting, though I might happen to do so. I believe all my barrels are capable of shooting closer than 2-inch groups with favorable weather conditions.

More information can be derived from the use of a double machine rest in a few hours than can be had by ordinary rest shooting by an ordinary shooter in as many weeks, as if at all carefully used, it has no human errors of holding and pulling. The results, therefore, are those due to rifle, ammunition, and weather only; the man is out of it except so far as his loading of the rifle and judgment of the wind are concerned. The mounts are all adjustable and clamp to the barrel, no screw holes or marring of the barrel being necessary. They take barrels of all ordinary sizes without change, the forearm being removed while testing. In use two stout posts are set deeply in the ground, the firmer the better, and are braced together. A smooth level plank is fastened on top. Both posts are firmly braced in two directions, stop is fastened on top plank in proper position, and rear rest to rear post so as to give approximately the correct elevation. Front rest and scope mountings are clamped to the barrel, the same loaded, and slid gently to stop. To sight on I prefer four black pasters, placed at the corners of a square about

2½ inches on a side. Adjust your rest or telescope, or perhaps both, so the gun points are where you wish, cross-hairs being between each pair of pasters. Let the rifle rest naturally, hold right hand about 6 inches behind the butt, touch the set trigger with the left hand, and catch the rifle on recoil. If the gun has a heavy pull pinch the trigger and guard with thumb and forefinger so as not to disturb the rifle in rest. In setting up it is often convenient to set the rest so the rifle will point on the target before the telescope is mounted; using the ordinary sights, then mount the scope and adjust it to your pasters, and shoot your group, then move the rest a fair amount, that depending on how close the gun will shoot, then bring your scope again to the pasters and shoot again. It very seldom pays to try to get the rifle to shoot at any given spot in testing. Hold in one spot and get your group wherever it happens to fall.

A telescope sight is not a necessity in double rest shooting, though it is a great convenience. With it you can shoot from a bench rest that is not firm, as the sight gives you a chance to correct the aim each time. For all that an absolutely firm bench is best, and if you shoot from a double rest without a scope it is an absolute necessity.

Directions for Handling Pope Muzzle Loading Rifles

Tie your false muzzle to the loading rack. This prevents your shooting it off and also prevents the gun from falling, as it is to be kept on the gun until ready to shoot.

Seat your bullet as soon as possible after firing so the powder dirt will not have time to harden and make it load hard. To seat the bullet stand the gun in the rack so the barrel will be vertical, breech open. Wipe off the muzzle with a bit of waste carefully with the blinder pin in line of sights; push it down gently; keep the muzzle pins clean and occasionally smear them with a bit of bullet grease. Place a bullet on the muzzle with the left hand, with the starter in the right hand, plunger down, place cup of plunger on point of bullet and slide the starter down onto the false muzzle; hold the starter down tight onto the false muzzle with the left hand and drive the bullet in the length of the starter plunger with *ONE BELOW* with the ball of the right hand. Strike in line of plunger and do not strike with the palm as it will hurt and make your hand sore. Do not strike several blows as the bullet upsets each time and goes with difficulty. Get the knack of the exact strength required and strike but once. Pull up the plunger with the right

hand while still holding the body down with the left so the plunger will not rub in the rifling and wear it. When the plunger is way up hold it there with your thumb and remove the starter from the muzzle, still holding the false muzzle to the barrel; with the knob. Take your ramrod and hold it short with both hands and push hard and straight to start the bullet part way down. Don't drive it—push, then shift your grip to the knob and push it gently clear down to the knob. Now—LISTEN—Leave your gun in the rack this way, muzzle tied to the rack, muzzle on barrel, rod way down, till you are ready to shoot. The fact that it is so shows you have seated a bullet to place and no injury can come to the barrel. Load shell and then remove the rod slowly to prevent suction; go to the firing point and look into the breech to see the bullet before you insert the shell to shoot.

Cautions

Always see that the rod is in the barrel as described before you shoot. That is a sure preventive of having a bullet seated and another started or of having the bullet only part way down.

If your shell should apparently miss fire, look into the barrel. If the bullet is still in it, go back to the stand and put on your muzzle and

put your rod down to place. Sometimes one puts on a primer only which drives the bullet up the barrel and if the bullet was not returned to place the next shot would bulge the barrel.

Don't lose your false muzzle, it cannot be duplicated.

Don't carry the false muzzle on your gun. If it should fall it is liable to injure both it and the barrel. Carry the ramrod in the barrel, then if it falls the wooden knob makes a cushion that prevents injury to the end of the barrel.

One way of injuring a barrel is to shoot a bullet part way down. This usually makes a powder ring. To shoot a bullet from the breech against one only started down ruins the barrel except for rebore to a larger size. Exploding a primer only and driving the bullet part way out to be ringed by the next powder charge, unless pushed back into place. Leaving the rod in place as above prevents all but the last of these.

NEVER insert the loaded shell till at the firing point.

Loads 2½ Peters primer, 5 grains weight FFG Semi Smokeless, 19 or 20 grains weight, of Du Pont's Schuetzen smokeless. This leaves the shell nearly full—postal card wad—bullet 1 part tin to 27 parts lead. This is a very accurate load with light recoil. I use it.

Another—Either 2½ Peters or No. 8 U.M.C. primer, 8 grains weight of Schuetzen Smokeless

or Du Pont's No. 1 Smokeless rifle; shell nearly filled with FG or FFG Semi Smokeless. Bullet 1 tin to 80 lead—postal card wad.

When through shooting, load a bullet as usual, but push it clear through with the cleaning rod. Wipe thoroughly and dry and grease with Pope's "Leadoff" which is a splendid rust preventer and also a very quick lead remover.

APPENDIX III

EXTRACT FROM "U. S. SMALL-ARMS FIRING REGULATIONS, 1918"

Place the rifle firmly in a rest 25 or 30 feet from a plank or wall, taking care that the piece is not cantered either to the right or left. Upon the wall or plank a sheet of blank paper should be tacked and the rifle sighted near its center. Changes in line of sights are made by changing elevation and windage of the rear sight. The soldier should sight carefully for a small black disk which is placed on the end of a short rod, pierced in its center with a hole just large enough to admit the point of a lead pencil and manipulated by another. The soldier sighting directs the marker to move the disk to the right, left, higher, or lower, until the line of aim is established, when he commands "Mark" or "Hold." At the command "Mark," being careful not to move the disk, the marker records through the hole in its center the position of the disk and then withdraws it. At the command "Hold," the marker holds the disk carefully in place without marking until the position is verified by the instructor, and the disk is not withdrawn until so directed. . . .

Soldiers will sometimes be found who do not know how to place the eye in the line of sight; they often look over along one side of the notch of the rear sight and believe that they are aiming through the notch because they see it at the same time that they do the front sight. This error will probably be made evident by the preceding exercise. Some men in sighting will not look at the front sight and not at the object. As this often occasions a blur, which prevents the object from being distinctly seen and increases both the difficulties and inaccuracies of sighting, it should be corrected.

Using the sighting rest for the rifle, require each man to direct the marker to move the disk until the rifle is directed on the bull's-eye, with the normal sight, and command "Mark"; then, being careful not to move the rifle or sights, repeat the operation until three marks have been made.

The triangle of sighting.—Join the three points determined as above by straight lines, mark the soldier's name, and call his attention to the triangle thus formed. The shape and size of this triangle will indicate the nature of the variations made in aiming.

Abnormal shape causes.—If the triangle is obtuse, angled, with its sides approaching the vertical, the soldier has not taken a uniform amount of front sight. If the sides of the tri-

angle are more nearly horizontal, the errors were probably caused by not looking through the middle of the notch or not over the top of the front sight. If any one of the sides of the triangle is longer than one-half inch, the instructor directs the exercise to be repeated, verifying each sight and calling the soldier's attention to his errors. The instructor will explain that the sighting gains in regularity as the triangle becomes smaller.

Verifying the triangle.—If the sides of the triangle are so small as to indicate regularity in sighting, the instructor will mark the center of the triangle and then place the center of the bull's-eye on this mark. The instructor will then examine the position of the bull's-eye with reference to the line of sight. If the bull's-eye is properly placed with reference to the line of sight, the soldier aims correctly and with uniformity. If not so placed, he aims in a regular manner but with a constant error.

Causes of errors.—If the bull's-eye is directly above its proper position, the soldier has taken in aiming too little front sight, or if directly below, too much front sight. If directly to the rest or left, the soldier has not sighted through the center of the rear sight notch and over the top of the front sight. If to the right, he has probably either sighted along the left of the rear sight notch or the right side of the front sight, or has committed both of these errors. If the bull's-

eye is too far to the left, he has probably sighted along the right of the rear sight notch or to the left of the front sight, or has combined both of these errors. If the bull's-eye is placed with reference to its proper position diagonally above and to the right, the soldier has probably combined the errors which placed it too high and too far to the right. Any other diagonal position would be produced by a similar combination of vertical and horizontal errors. As the errors thus shown are committed when the rifle is fixed in position, while that of the bull's-eye or target is altered, the effect will be directly opposite to the changes in the location of a hit in actual fire, occasioned by the same errors, when the target will be fixed and the rifle moved in aiming.

APPENDIX IV

GLOSSARY

Angle of departure.—The inclination or vertical angle between the line of vision and the initial direction of the bullet produced. It differs from the angle of elevation in that the delivery of the bullet is affected by the "flip" of the barrel.

Angle of elevation.—The inclination or vertical angle between the line of vision and the axis of the bore produced.

Axis of the bore.—An imaginary straight line through the center of the bore produced.

Caliber of bore.—The diameter of the bore measured between the lands or raised spiral portions between the grooves in a barrel.

Cant.—To hold the rifle so that the sights are inclined to the right or left while aiming.

Drift.—The lateral deviation of the bullet from the line of fire caused by its rotation on its long axis, independent of the effect of a side wind.

Elevation scale.—The graduations on leaf or rear sight indicating the required position of peep or notch for various distances.

Fall of bullet.—The vertical distance through which a bullet in flight drops from the line of axis of the bore.

Line of fire.—The direction of the bullets' flight in a vertical plane.

Line of sight.—When aiming: an imaginary straight line from the eye through the center of the peep, or rear sight, and the tip of the front sight, produced to meet the object aimed at.

O'clock.—A term used to indicate, by the position of the figures on a clock or watch, the location of a hit on the target, or the direction *from which* a wind is blowing. In the former case the top of the target is 12; the bottom 6; facing the shooter. In the latter case, the shooter is supposed to be at the center of the dial and the target at 12; the shooter's right side is 3 and his left side 9.

Sight radius.—The distance between tip of front sight and the center of the peep or notch of rear sight when raised.

Trajectory.—The curved path of a bullet in a vertical plane extending from muzzle of rifle to point of impact.

Twist.—The spiral formed by the grooves in the bore of a rifle. It is measured by the length of the barrel, in inches, in which the spiral makes one complete turn.

Velocity.—The forward speed possessed by a bullet at any point in its flight, expressed in feet per second.

Wind Gauge.—The graduations on rear sight, used to measure the corrections for lateral deflection of the bullet by wind.

Bore.—The cylindrical cavity in the small-arms barrel.

Grooves.—The spiral channels within the bore of the rifle barrel.

Lands.—Spaces in the bore of the rifle barrel between the grooves.

Mirage.—A word used to designate the heat waves observed on the target range on warm days. The waves indicate the direction in which the air is moving.

Telescopic sight.—A telescope or other magnifying device attached to the barrel of the rifle, for getting while aiming, a better definition of a distant objective, provision being made for adjustments in elevation and for windage.

Windage.—The influence of the wind in deflecting the bullet from the point at which it is aimed; also applied to the amount of change made on the wind gauge.

APPENDIX V

SCORE SHEET OR CARD EMPLOYED BY THE AUTHOR

The method of recording shots with the score sheet is as follows: Data as to weather, powder, etc., are filled in from instruments on the range.

The value of the shot is recorded in the center circle and the location in the outer. Thus, a shot value of five at the left edge of the bull would have the figure 5 in the center circle and a dot on the outer circle at 9 o'clock.

The shots can be transferred very accurately and plotted correctly on the facsimile of the target; the minutes of angle of elevation and the amount of movement of wind gauge for changing conditions are recorded for each shot.

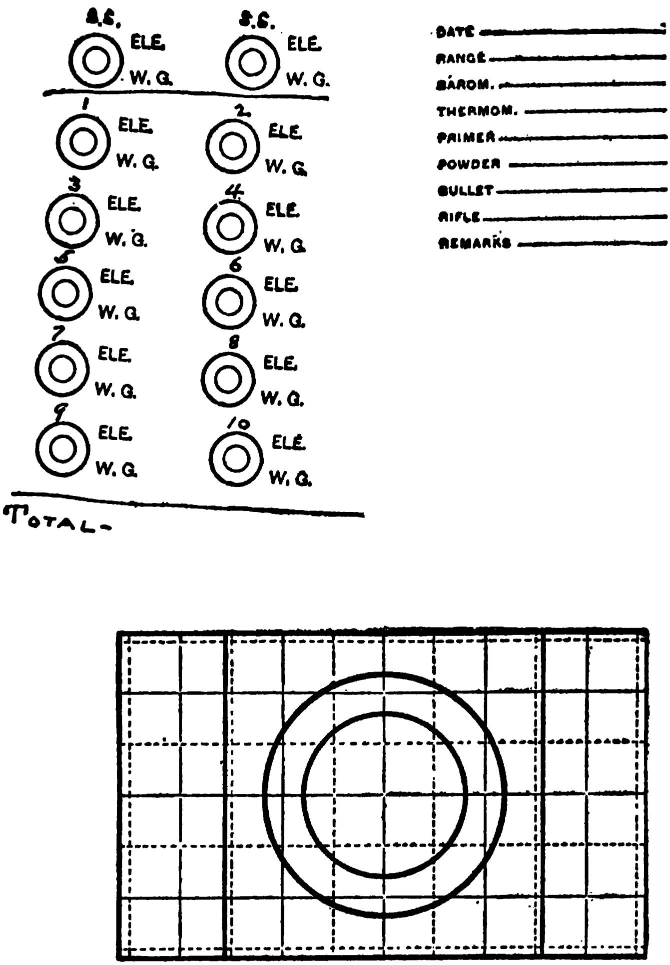


FIGURE 81. PAGE FROM AUTHOR'S SCORE BOOK. FIGURES MADE WITH SPECIAL RUBBER STAMPS

APPENDIX VI

TABLES OF LOADS, PRESSURES AND VELOCITIES IN ACTUAL FIRING BY THE AUTHOR TO OBTAIN DATA FOR THE CARTRIDGES RECOMMENDED IN CHAPTER X

The cartridges were loaded by the author, the weights of powder charge being checked at the time of loading by H. M. Pope. The pressures taken at New Haven by the Winchester Arms Company's crusher gauge were recorded with an initial compression on the upper cylinder of 46,000 pounds in the case of the Springfield; those taken at Wilmington by the Du Pont Company's ballistics laboratory were recorded with no initial compression on the cylinders. The velocities for the Springfield cartridges were taken simultaneously with the pressures on the crusher gauge, and the results tabulated can be absolutely relied upon. The velocities and pressures for the Krag 30/40 cartridges were taken separately with a side-block gauge and chronograph.

As the velocities given are at 150 feet, 68 foot-seconds should be added in each case to obtain muzzle velocity.

KRAG 30, U. S. 1898, 30/40 CARTRIDGE; AVERAGES OF FIVE-CARTRIDGE GROUPS EXCEPT AS INDICATED

Shell	Primer	Powder	Charge, grains	Bullet	Velocity, ft.-seconds	Pressure, pounds	Shot
Winchester	U. M. C. 8	Du Pont 17	41	Winchester 180 solid	2,379	40,100	Wilmington, Dec., 1919
"	"	" 17	41	"	2,380	side-block 42,830	New Haven, Dec., 1919
"	"	"	41	"	2,364	40,070	Wilmington, Dec., 1919
"	"	16	41	"	2,415	43,980	New Haven, Dec., 1919
Winchester 4 cartridges	"	" 17	42	Newton 172 soft-pt.	2,506	side-block 47,000	New Haven, Dec., 1919
Winchester 4 cartridges	"	" 17	42	"	2,406	41,200	Wilmington, Dec., 1919
Winchester 4 cartridges	"	" 16	42	"	2,500	45,150	New Haven, Dec., 1919
Winchester 4 cartridges	"	" 16	42	"	2,423	41,070	Wilmington, Dec., 1919
Winchester	Winchester N. M. 35	" 17	34	Winchester 220 solid	1,960	34,000	New Haven, Dec., 1919

Springfield 30, U. S. 1903, 1906 Cartridge; Averages of Five-Cartridge Groups

Shell	Primer	Powder	Charge, grains	Bullet	Velocity, ft.-seconds	Pressure, pounds	Shot
U. M. C.	U. M. C. 8	DuPont 17	49	U. M. C. 180 Umb.Crimp.	2,654	56,475	Bridgeport, April, 1919
"	"	" 17	48.7	"	2,666	53,250	New Haven, Oct., 1919
"	"	" 17	48.7	Winchester	2,688	54,160	Wilmington, Oct., 1919
"	"	" 17	48.8	180 solid	2,623	54,720	New Haven, Dec., 1919
"	"	" 17	48.7	"	2,623	50,300	New Haven, Oct., 1919
"	"	" 17	48.7	"	2,625	48,460	Wilmington, Oct., 1919
"	"	" 16	48.8	"	2,610	54,920	Wilmington, Dec., 1919
"	"	" 16	48.8	"	2,611	53,640	New Haven, Dec., 1919
"	"	" 17	48.8 + 1 tin	"	2,585	52,520	New Haven, Dec., 1919
"	"	" 17	48.8 + 1 tin	"	2,580	52,580	Wilmington, Dec., 1919
Winchester "	Winchester N. M. 35	" 15	53	"	2,682	52,140	New Haven, Dec., 1919
"	"	" 15	53	"	2,670	55,800	Wilmington, Dec., 1919
U. M. C.	U. M. C. 8	" 17	49	Newton 172 soft-pt.	2,543	46,470	New Haven, Dec., 1919
"	"	" 16	49	"	2,538	47,980	New Haven, Dec., 1919
"	"	" 17	49	"	2,546	48,720	Wilmington, Dec., 1919
"	"	" 16	49	"	2,564	49,480	Wilmington, Dec., 1919
"	"	1094.1	59	Winchester 180 solid	2,700	51,780	Wilmington, Dec., 1919 (special)

APPENDIX VII

BALLISTIC TESTS OF NEW 30-CALIBER, 180-GRAIN EXPANDING BULLET DESIGNED BY COLONEL JOHN CASWELL

These tests were made at the range of the Winchester Repeating Arms Company, New Haven, Connecticut, on March 10, 1920. The charge in each case was 51.5 grains of I.M.R. No. 14 powder.

Velocity at 78 feet in Springfield '03 rifle No. 228238:

Maximum	2,668	foot-seconds
Minimum	2,626	"
Average (3 shots)	2,652	"

Pressure taken on Frankford Arsenal gauge No. 222972:

Maximum	45,200	pounds
Minimum	43,500	"
Average (5 shots)	44,640	"

Accuracy at 500 yards in Springfield '03 rifle No. 636076, regulation Frankford rest, 10-shot groups:

	Vertical, inches	Horizontal, inches	Nine Shots Vertical, inches	Mean Radius, inches
Group 1	7.5	10.2	5.7	3.88
" 2	15.5	8.5	14.4	5.10
" 3	16.5	12.9	14.8	5.85
" 4	11.2	10.7	7.3	4.70
" 5	12.3	11.4	9.7	4.20
Average	12.5	10.7	10.4	4.75

In penetration tests through 7/8-inch pine boards at 25 feet in Springfield '03 rifle, bullets were recovered as follows: One in the 15th, one in the 18th, one in the 20th, one in the 26th, the average penetration being 19¾ boards. Bullets started to upset on entering the fifth board.

Tests were also made using the regular 180-grain pointed full-patched and 30-caliber U. S. '06 shells. A charge of 53.5 grains of I.M.R. No. 14 powder was established to give approximately 2,700 foot-seconds muzzle velocity.

Velocity at 78 feet in Springfield '03 rifle No. 223233:

Maximum	2,655	foot-seconds
Minimum	2,624	"
Average (3 shots)	2,642	"

Pressure taken on Frankford Arsenal gauge No. 222972:

Maximum	50,000	pounds
Minimum	46,550	"
Average (5 shots)	47,810	"

The above figures are the latest data for the 180-grain special game bullet. It should be re-

membered, however, that changes and improvements in powder composition and primers are being made not only from week to week but almost from day to day, and that any decided improvement as to range and accuracy will probably be due to bullet construction rather than to changes in propelling charge.

APPENDIX VIII

A SELECT CHRONOLOGICAL BIBLIOGRAPHY OF THE RIFLE

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FIGURE 76. PERCUSSION TARGET RIFLE, GERMAN, BUT WITH ENGLISH PROOF MARKS, ABOUT 1850; CHARGE, 40 GRAINS F. F. G. BLACK POWDER; SUGAR-LOAF BULLET, 401 CALIBER, WEIGHT 160 GRAINS

FIGURE 60. MOOSE SHOT ON THE PATAPEDIA RIVER, QUEBEC, CANADA, OCTOBER, 1903; GREATEST WIDTH OF HORN, 64⅝ INCHES